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*THE MEDICAL SCHOOL OF THE FUTURE.**

AMONG the intellectual movements that have characterized the century now drawing to a close there is perhaps no one more deserving of careful study than that which is concerned with providing education for people in the school, the academy and the university. The importance of popular education became apparent in proportion as political freedom was secured for the people. Thus Viscount Sherbrooke, better known as the Hon. Robert Lowe, in the reform debates of 1866 and 1867, after the passage of a bill for the extension of the suffrage, uttered the well known words: "We must now at least educate our masters." The same sentiment has also more recently been embodied in the inscription on the Boston Public Library. "The Commonwealth requires the education of the people as the safeguard of order and liberty," and in the presidential address of Dr. J. M. Bodine,† at the meeting of the Association of American Colleges in 1897 we find the same idea thus expressed, "In America the citizen is king. The king must be educated to wield aright his ballot-sceptre."

For many years educators looked upon their work with no little complacency. The educational systems of the various civilized

* Address by the president before the Fifth Triennial Congress of American Physicians and Surgeons given at Washington on May 2nd.

† *American Practitioner and News*, June 26, 1897.

countries were supposed to be well adapted to the ends in view, and educational exhibits have been generally regarded as important features of international expositions. But within the memory of most of those now before me signs of serious discontent have not been wanting. Education has not always been found to furnish the required safeguards for order and liberty. Highly educated men have often been found singularly lacking in mental balance. Schools for the inculcation of 'common sense' have never yet been established. Even the great development of psychology as an experimental science, which has occurred chiefly within the last twenty-five years, though it has served to establish many laws of mental action, has thus far failed to justify the hope that pedagogy may find in psychology a foundation for the erection of rational systems of education. Indeed we have recently been told by one of the ablest expounders of this science that it is a great mistake for teachers to "think that psychology, being the science of the mind's laws, is something from which they can deduce definite programs and schemes and methods for immediate schoolroom use. Psychology is a science and teaching is an art. A science only lays down lines within which the rules of the art must fall, laws which the follower of the art must not transgress: but what particular thing he shall positively do within those lines is left exclusively to his own genius."*

Even this general guidance has been very imperfectly afforded, for the limits set by the science of psychology to the art of teaching have never been precisely defined. In fact the most fundamental question of all, viz, the relation of mental to physical development has not yet been settled, though much material for its study has been collected. It is not therefore surprising that in many countries teachers have made too great demands upon the time and strength of growing children.

This has been clearly the case in some parts of Germany where schoolboys from eight to fifteen years of age have found their vital energy so far exhausted by the school work required of them that they have lost all inclination for vigorous athletic amusements so naturally indulged in by Anglo-Saxon boys. The deterioration of the race as a result of too close application to intellectual pursuits, to the neglect of the physique, has been fortunately obviated, in the case of Germany, by the army system which takes entire possession of the youth before it is too late and, by requiring him to devote three years to the education of his body, turns him out, at the end of that period, a young man with mind and body, trained to a high degree of efficiency, well fitted for civil as well as military pursuits and comparing favorably in all respects with men of his age in other nations. Looked at from this point of view the German army must be regarded as an important part of the educational system of the country though as a piece of educational machinery its workings cannot be considered economical. In fact the absurdity of depending upon the army to remedy the defects of the school system has long since been forced upon the attention of German educators and the difficulties above alluded to are now in a fair way to be removed.

In our own country difficulties of quite a different kind have been met with. Here the great danger which threatens our system of popular education arises from its close association with party politics. The office of a school committee man in one of our large cities has been well described as "the smallest coin in which politicians pay their debts," and as long as the education of our children continues to be entrusted largely to men who consider their position on a school board as the lowest step of the political

* W. James, 'Talks to Teachers,' p. 7.

ladder, there is small hope of the adoption of rational methods of education. Moreover this intimate alliance between education and politics greatly aids the efforts of persons more zealous than discreet to direct the instruction of children in accordance with their own special views. Thus nearly all the states of the union have upon their statute books laws requiring the physiological action of alcohol to be taught to children in all grades of the public schools. These laws violate the first principles of pedagogy inasmuch as the physiological action of a drug cannot possibly be understood without a familiarity with anatomy, physiology and chemistry which school children cannot be supposed to possess. They have been passed at the bidding of total abstinence associations, sometimes in opposition to the earnest protests of the teachers entrusted with their execution. How these excrescences upon our educational system may be best removed and the work of instruction placed under the control of those best qualified to direct it are questions demanding serious consideration.

I have mentioned these instances in which great educational systems have been found wanting merely for the sake of pointing out that the critics of our methods of medical education, who, as Professor Exner* has shown, are now raising their voices in every land, do but give a special expression to a wide spread feeling that our educational systems are not accomplishing all the objects for which they have been devised, and that the discontent which they imply is but a healthy dissatisfaction with the results thus far accomplished. May the time be far distant when those in charge of our educational interests shall rest content with what they have achieved, for this will indicate that a state of stagnation has been reached similar to that which characterizes the institutions of the Celestial Empire, and that no further attempt is to be made to adapt our methods of instruction to the constantly widening domain of human knowledge and experience.

It may, perhaps, be well for me at this point to offer a few words in explanation of the selection of such a well-worn theme as medical education as the subject of my remarks this evening. It is true that in recent years the subject has been a favorite one with those who have been called upon to address medical associations or classes of graduating students, and if, in spite of this fact, I venture to add another address to the fast growing literature of the subject, my justification may be found in the following reasons: In the first place it must be borne in mind that such addresses are very quickly forgotten "Were it not so," as Dr. Billings has remarked, "it would be a hard world for address-givers." In the second place, the progress of medicine at the present time is so rapid that new points of view are constantly being secured, and it is, therefore, not at all impossible that, even at comparatively short intervals, new and valuable suggestions may be made both with regard to subjects to be taught and to methods to be employed in giving the instruction.

Lastly, it so happens that during the academic year, now nearly completed, the faculty of the Harvard Medical School has inaugurated an entirely new plan of instruction in the sciences of anatomy, physiology and pathology. This scheme, though still in the experimental stage, embodies ideas of such fundamental importance in medical education that its presentation to a representative body of the medical profession seems to me to be peculiarly appropriate.

I shall, therefore, ask you to consider with me this evening what lessons the faculty of a modern medical school may draw from recent advances in medical science and recent experience in medical education or, in other words, on what lines the in-

* *Wiener Klinische Wochenschrift*, 1900, No. 3.

struction of a medical school of the first rank is likely, in the immediate future, to be organized. I say in the *immediate* future for what changes are in store for us in the course of the next few decades it is equally impossible to foresee and useless to speculate.

RELATION OF MEDICAL SCHOOLS TO UNIVERSITIES.

One of the most hopeful signs of the times in the field of medical education is the growing tendency of the better schools to ally themselves to universities and of universities to establish medical departments. Of the great advantages to medical education which may be expected from this union it is unnecessary for me to speak, for they formed the subject of a thoughtful discourse delivered by the last president of this congress at Yale University in 1888.* The twelve years that have elapsed since he spoke have brought accumulating evidence of the soundness of his views. In fact, it is difficult to see how a private medical school of the joint stock company type can ever, in the future, rise to the first rank, for such a school is not much more likely to attract endowments than a cotton mill, and without endowments the enormous expenses of a modern first-class medical school cannot possibly be met.

Great as are the benefits to a medical school of thus forming a department of a great university, the advantages of the union are not wholly on one side. Besides the increase of prestige secured to the University by the broadening of its functions, the establishment of a medical school as part of the university organization greatly facilitates the instruction of those students who, without any intention of becoming physicians, seek in the study of the medical sciences a means of general culture and mental discipline.

* *New Englander and Yale Review*, Sept., 1888.

The relations between the governing body of a university and its medical faculty in matters of administration are often defined by custom and tradition rather than by statutory provisions, and vary considerably in different institutions. In general, two methods of government may be distinguished. Either the initiative is left with the teaching faculty, the governing body exercising simply a veto power, or the governing body acts directly without necessarily asking advice from the faculty or its members. The former method of government is most likely to be found in those cases in which a well-established medical school has allied itself to a university for the sake of the mutual benefits that may ensue from the union, and the latter method in those cases in which a university has completed its organization by the creation of a medical department. Both methods have certain advantages and neither is without its drawbacks. In all cases men are more important than methods. On the one hand, the collective judgment of a teaching faculty on matters relating to medical education, is likely to be of more value than that of a governing body which may not, and generally does not, include physicians among its members. On the other hand, personal and selfish considerations are perhaps more apt to sway the judgment of a faculty than that of a body of trustees, especially when the question is that of the appointment of teachers. That this is not a serious danger, however, the experience of Germany seems clearly to show, for in that country, as Dr. Farlow has recently pointed out, the faculty 'has more power in regard to appointments and the general policy of the university' * than with us, and yet we find there the custom of calling professors from one university to another, fully established; a custom which

* Presidential address. Am. Soc. of Naturalists, Dec., 1899. SCIENCE, Jan. 5, 1900.

must be regarded as one of the strongest influences in maintaining a high standard of educational efficiency. On the whole, therefore, even with this possibility of error, the judgment of a faculty would seem to be the safer guide, and there are probably few boards of trustees who would feel themselves justified in disregarding it altogether.

The above-mentioned advantages of a union between a medical school and a university will naturally become more obvious as the problems of medical education become more complex, and the methods of instruction more costly. Hence we may expect in the near future to find all of the better class of medical schools under the ægis of a university, and we may reasonably hope that this change will be associated with a diminution of the total number of medical schools now so greatly in excess of the needs of the country.

The union of a medical school with a university at once compels the consideration of the proper relation between the academic department and the professional school. To say that the former should be the feeder of the latter and that the holding of an A.B. degree should be the condition of admission to professional studies, is to adopt the position taken by two of our leading medical schools. The A.B. degree, however, since the introduction of the elective system, no longer stands for a definite amount and kind of training. Hence the Johns Hopkins Medical School demands not only the diploma, but also evidence of ability to read French and German and of laboratory training, in physics, chemistry and biology. The Harvard Medical School is content to accept the A.B. diploma as evidence of fitness to pursue professional studies, stipulating only that the holder shall possess an adequate knowledge of inorganic chemistry. Whether the example set by these schools will be generally followed is quite doubtful. Without undervaluing the importance of collegiate training as a preparation for a professional career it may perhaps be contended that a properly conducted admission examination is a better test of fitness to pursue the study of medicine than the possession of a diploma the value of which varies so much with the character of the college bestowing it. Moreover, the possibility that a young man, unable to afford the expense of a college course, may yet by private study prepare himself for a professional career is not to be lost sight of. Hence the Harvard school provides for the admission by special vote of the faculty of young men, not holders of an A.B. degree, who may furnish satisfactory evidence that they have obtained an equivalent education and that they are consequently able to profit by the instruction which the school has to offer.

The recent lengthening of the course of study, from three years to four, in all the best medical schools of the country, has drawn renewed attention to the importance of enabling the student who takes the A.B. degree as a preparation for medicine, to so far shorten the sum total of the time devoted to his education, that he may be able to enter upon the work of his profession at an age not in excess of that at which his European confrères begin their career as practitioners. A few years ago an examination of the best accessible evidence on the subject led to the conclusion that foreign systems of university education enabled students of medicine to enter upon their life-work at least two years earlier than was possible for the alumni of Harvard College, a condition dependent upon the fact that the changes in the academic department, which had raised the age of graduation, had been made with little regard to the interests of the professional schools, and chiefly for the purpose of making the undergraduate department as complete as possible in itself. In other univer-

sities a similar condition existed, though probably not in the same degree, as in Harvard.

That the American medical student, seeking the best possible preparation for his profession, is seriously handicapped by these conditions has been generally recognized, and the question of the best method of meeting the difficulty has been widely discussed. The most thorough treatment of the case consists in reducing the academic course to three years. Less radical methods are the provision in the academic department of courses of instruction by which students may anticipate a part of their professional work, and the permission to count the first year of a professional course as the fourth year for the bachelor's degree. The first and most radical method meets with strenuous opposition, owing to the deeply-rooted traditions which surround the four years' academic course in this country, while the other plans violate what in some colleges seems to be regarded as an educational axiom: that one course of study should not count toward two degrees. It is interesting to notice that, without any specific legislation to this end the quiet working of the elective system has, in Harvard College, practically solved the problem by bringing about a condition in which, as President Eliot says:* "Any young man of fair abilities can now procure the degree in three years without hurry or overwork, if he wishes to do so or his parents wish to have him." The President further ventures to predict that "within a time comparatively short, the majority of those who enter the Freshman class will come to college with the purpose of completing the requirement for the degree in three years." As soon as a three years' residence becomes the rule rather than the exception, a young man spending four years in college will, of course, be regarded either as deficient in mental capacity or as having wasted his time.

That a reduction of the academic course to three years is an advantage to students looking forward to a professional career, or to further study in a graduate school is too obvious to need discussion, but it is interesting to find the change advocated in the interest of the undergraduates themselves. Professor Clement L. Smith, for nine years Dean of Harvard College, points out* that there is a large and influential class of college men who get into the habit of frittering away their time simply because they have so much of it and that "for them and for those whom they influence—and these make up the largest part of the class we are now considering, the men who go from college into active life—the reduction of the course would be a distinct gain." Nor need we fear (as has sometimes been urged) that, in thus reducing the length of the college course, we shall lose the fourth and most valuable year, for as Professor Smith says: "The senior year is the best year, not because it is the fourth, but because it is the last year. The causes which make it what it is come from before, not from behind; from the consciousness of opportunity passing away and of the serious problems of life close at hand. The period of waste lies between the fresh zeal and good resolutions with which the youth begins his course, and the growing sense of responsibility with which he draws near its close. It is this intermediate period that would be shortened, in the briefer course. It is not the senior year that would be cut off; it is rather, let us say, the sophomore year, and with it might well go its absurd name."

It thus appears that the claims of the college and of the professional school upon the time of the student are in a fair way to be harmoniously adjusted.

* Annual reports of the president and treasurer of Harvard College, 1898–99, page 10.

* The American College in the Twentieth Century, Clement L. Smith, *Atlantic Monthly*, Feb., 1900.

THE ELECTIVE SYSTEM.

Let us now consider in what way the medical school of the immediate future is likely to differ from that of the present time with regard to the subject matter of instruction. The most striking phenomenon presenting itself to the educator of today is the recent enormous widening of the educational horizon. "The immense deepening and widening of human knowledge in the nineteenth century and the increasing sense of the sanctity of the individual's gifts and will power"* are the fundamental facts which underlie the development of the elective system, but it is important to bear in mind that, as Professor Smith observes,† this development has been "due not so much to increase of knowledge—for not all new knowledge is straightway fit for educational purposes—but rather to the conversion of new fields of knowledge to the uses of education."

A discussion of the elective system of education with its attendant advantages and dangers would require far more time than I have at my disposal and I must content myself with pointing out the possibility that, in this period of transition, the educational pendulum may have swung to an extreme position and that too much attention has been given to the accidental differences of pupils while the essential similarity of their natures has been lost sight of. In discussions on individuality as a basis for the elective system one sometimes hears the statement (attributed to Leibnitz) that no two leaves of the same tree are alike. This dissimilarity however, does not prevent them from all elaborating the same sap and it is, moreover, always associated with sufficient essential similarity to enable any one, with even the most elementary knowledge of trees, to distinguish the leaves of an oak from those of a maple.

While admitting that some of the extreme positions now maintained by the advocates of the elective system may, in the future, have to be abandoned, no one can doubt the wisdom of adapting the education to the powers of the mind to be educated and of allowing, in the case of advanced students, the choice of the individual to be a determining factor in the selection of studies. Let us, therefore, enquire to what extent the elective system may properly find a place in the curriculum of our medical schools. That it forms an essential feature of our postgraduate schools of medicine scarcely needs to be mentioned, for these schools have been organized for the express purpose of enabling graduates in medicine to select such subjects for study as may seem to them desirable and to acquire more advanced knowledge than was possible in the undergraduate course. Moreover, in some of our larger schools, since the establishment of the compulsory four years' course, a portion of the instruction of the fourth year has been given in elective courses in various specialties. The elective system in medicine is, therefore, not altogether a novelty, and the question now before us is whether it may be profitably extended to the earlier years of the course.

In his remarks at the dinner of the Harvard Medical Alumni Association in 1895, President Eliot used the following language: "There ought to be in the Harvard Medical School an extended instruction far beyond the limits of any one student's capacity. This involves, of course, some optional or elective system within the school itself, whereby the individual student should take what is, for him, the best four years' worth, the faculty supplying teaching which it might take a single student eight, twelve or twenty years to pursue."*

One year ago last December, in an address which I had the honor to deliver in

* C. W. Eliot, *Atlantic Monthly*, Oct., 1899, p. 443.

† C. L. Smith, *Atlantic Monthly*, Feb., 1900, p. 219.

* Bulletin Harv. Med. Alumni Assoc., No. 8, p. 40.

New York before the American Society of Naturalists,* I gave the reasons which seemed to me conclusive in favor of this extension of the elective system and, with your permission, I will take the liberty of presenting as briefly as possible the views there set forth.

In the first place it may be assumed that a medical school of the first rank should be an institution in which the most advanced instruction in all departments of medicine can be obtained, and on this assumption it is, of course, impossible to arrange a course of study that every student must follow in all its details, for, in the time which may properly be devoted to a course of professional study, it is quite impossible for even the most intelligent students to assimilate all the varied information which such a school may be reasonably expected to impart.

It seems, therefore, to be evident that in arranging a course of medical study a distinction must be made between those subjects which it is *essential* that *every* student should know and those subjects which it is *desirable* that *certain* students should know, that is, between those things of which no man who calls himself a physician can afford to be ignorant and those which are important for certain physicians but not for all; in other words, provision must be made both for required and for elective studies. The task of drawing the line between the essential and the desirable in medical education will require the greatest possible good judgment and readiness for mutual concession on the part of those engaged in the work, but there is no reason to fear that the difficulties will be found insuperable when the importance of the change has once been recognized.

Any one who is familiar with the existing methods of medical instruction is aware that in nearly every department many things are taught which are subsequently found to be of use to only a fraction of those receiving the instruction. Thus the surgical anatomy of hernia is taught to men who will subsequently devote themselves to dermatology, future obstetricians are required to master the details of physiological optics and the microscopical anatomy of muscles forms a part of the instruction of men destined to a career as alienists. Now no one can doubt the propriety of including instruction on all these subjects in the curriculum of a medical school, but it may be fairly questioned whether every student should be forced to take instruction in them all.

To better indicate the nature of the reform which I am advocating, allow me to describe a possible arrangement of a course of study in the department of physiology, with which I am of course more familiar than with any other. An experienced lecturer will probably find it possible to condense into a course of about forty or fifty lectures all the most important facts of physiology with which every educated physician must necessarily be familiar. Attendance upon these lectures, combined with suitable courses of text-book instruction and laboratory work, would suffice to guard against gross ignorance of physiological principles. In addition to this work, all of which should be required, short courses of not more than eight or ten lectures each, should be provided, giving advanced instruction in such subjects as the physiology of the special senses, cerebral localization, nerve-muscle physiology, the internal secretion of glands, the physiology of the heart, circulation and respiration, the digestive secretions, the reproductive organs, etc. These courses should be elective in the sense that no student should be required to take them all. Each student might, however, very properly be required to choose a certain number of

*See Science, N. S., Vol. VIII., No. 209, p. 921 and *Boston Med. and Surg. Journal*, December 29, 1898.

courses, which, when once chosen, become, for the student choosing them, required courses leading to examination. There is in my opinion, no doubt that an arrangement of instruction similar to that here suggested for physiology could be advantageously adopted in the departments of anatomy, histology, bacteriology, medical chemistry, pathology, surgery, and in the courses of instruction in the various special diseases, such as dermatology, ophthalmology, etc.

In the existing state of medical education the introduction of the elective system in some form or other seems to be an essential condition to any further important advance, for the curriculum of most of our schools is already so crowded that no considerable amount of instruction can possibly be added. Various arguments may, of course, be advanced in opposition to the change. It may perhaps be urged that no choice of studies can be made without determining to some extent the direction in which the work of a future practitioner is to be specialized and that such specialization cannot be properly and safely permitted until the student has completed his medical studies. To this it may be answered that, whatever may be the dangers of too early specialization, the dangers of crowding the medical course with instruction of which many students do not feel the need, and of thus encouraging perfunctory and superficial work, are a certainty no less serious. It is, moreover, a matter of common observation among teachers in medical schools that a certain number of students very early make up their minds either that they will become surgeons, obstetricians, or specialists of some sort, or, on the other hand, that they have a strong aversion to certain branches of medicine and a determination never to practice them. For such students a prescribed curriculum necessarily involves great loss of time and energy.

If it be said that under this system the medical degree will cease to have the definite meaning now attached to it and that it will be impossible to tell from his diploma in what way a physician has been educated, it may be replied that, though the degrees of A.B., A.M., Ph.D. and S.D. are affected with exactly this same uncertainty of signification, their value seems in no way diminished thereby. As long as the M.D. degree stands for a definite amount of serious work on medical subjects, we may be reasonably sure that those who hold it will be safe custodians of the health of the community in which they practise.

If it be urged that the elective system in medical education will lead to the production of a class of physicians who, owing to the early specialization of their work, will be inclined to overrate the importance of their specialty and to see in every disease an opportunity for the display of their special skill, it may be pointed out that this result is apt to be due not so much to early as to imperfect instruction in the work of a specialist, and that since the elective system tends to encourage thoroughness in special instruction, the evil may be expected to diminish rather than to increase.

METHODS OF INSTRUCTION.

Having thus recognized the necessity of remodeling our conception of the subject matter to be taught and noted the importance of distinguishing between the essential and the desirable in medical education we must next consider by what methods the needed information may be best imparted and the necessary training secured. There is perhaps no way in which modern educational methods differ more from those of an earlier period than in the greater prominence given to object lessons. Beginning with the kindergarten the child is trained to cultivate his power to observe accurately and to manipulate skilfully and, through his school and college life, prominence is

given to the objective side of education to an extent which would have seemed to the book-trained pedagogues of a former generation but ill adapted to provide the well-stored mind which it was thought to be the principal object of education to secure. In the professional schools also the reaction against purely didactic methods has been strongly felt. Even in those professional pursuits to which the object method might seem at first sight least applicable, in the study of the law, the so-called 'case method' of instruction has been found to exert a vivifying influence.

In medical education in this country it is interesting to note that, in the very beginning, the instruction was more objective in its character than at a somewhat later period. In those early days it was in the office of his preceptor and at the bedside, as his actual assistant, that the embryo physician was initiated into the mysteries of his calling. Then followed a period when it was clearly perceived that the trained mind is necessary to interpret the data of observation and that mental training is essential to correct observing. Hence schools were established to provide this training by means of systematic didactic lectures covering all the departments of medicine and usually extending over not more than four months. These schools were intended at first merely to supplement the work of the preceptors but in process of time the relative importance of these two educational agencies was reversed and the work of the preceptors, became supplementary to that of the schools. The function of the preceptors finally became so subordinate that their names no longer appeared in the catalogues though this did not always indicate that they had ceased to afford students opportunities for practical clinical work.*

*See address by Henry Hun, M.D., *Albany Medical Annals*, October, 1896.

The schools, once established, grew chiefly by an increase in the length and number of the lecture courses as new and important subjects forced themselves upon the attention of the medical profession. Against this undue extension of purely didactic methods of instruction a reaction has now set in and during the last ten or fifteen years loud voices have been raised in advocacy of more objective methods than those at present in use. It is not, however, the reinstatement of the preceptor that is urged but rather the greater use of laboratory methods in the strictly scientific departments of medical instruction and their application as far as possible at the bedside of the patient. A fruitful discussion of the relative advantages of the laboratory, the lecture and the text-book as methods of medical education cannot be undertaken without a recognition of the fact that this education has a double object. In the first place the faculties of the student are to be so trained that he may observe carefully, reason correctly, study effectively and judge wisely; in other words, he is to be 'trained for power' to use President Eliot's phrase. In the second place there must be imparted to him a sufficiently large fraction of the acquired medical knowledge of the time to make him a safe custodian of the health of the community. Which of these two objects is the more important is a question which we need not now discuss, but even if we grant all that is claimed by the advocates of training for power it is evident that the constantly increasing range of subjects with regard to which an educated physician must be informed will greatly reduce the time which, in the curriculum of a medical school, may properly be devoted to courses of instruction not intended to impart direct and valuable information. In fact, 'training for power' should be largely a function of the academic department of a university, and, when undertaken

in a professional school, should be so directed as to impart at the same time the greatest possible amount of useful information.

Let us now consider how far the didactic and the laboratory methods of instruction are each adapted to secure these two objects of medical education. For the purpose of training for power no one can doubt the value of the laboratory method. Contact with the phenomena themselves and not with descriptions of them has a stimulating effect upon the mind of a student, the importance of which it is difficult to exaggerate, but it does not follow from this that the lecture, the recitation and the text-book are worthless as methods of training. It is here that some of the advocates of laboratory methods have committed what appears to me a serious error such as is too apt to characterize all reform movements, the error, namely, of assuming that because one proposition is true, another proposition, not logically inconsistent with it, must be untrue. "These gentlemen," as Professor Howell* has expressed it, "having become possessed of the golden truth that the best knowledge is that which comes from personal experience, seem disposed to deny all value to knowledge communicated from the experience of others." We are told, for instance, by Dr. Burr,† that the didactic lecture "dates from the time when printing was unknown and manuscripts were rare and almost priceless and the only means of communicating knowledge was by word of mouth. To-day it is in large part an anachronism, because the time devoted to it could be put to better uses."

In his able address‡ at the last Yale University Medical Commencement my colleague, Dr. C. S. Minot, expressed himself as follows: "The very best that can be said of a lecture or a book is that it describes well the knowledge which someone possesses. There is no knowledge in books. * * * A book or a lecture can serve only to assist a man to acquire knowledge with lessened loss of time. Knowledge lives in the laboratory; when it is dead we bury it decently in a book. * * * A lecture is a spoken book." I venture to believe that Professor Minot's students will hardly agree with this estimate of the lifeless character of either his written or his spoken instruction.

In place of these rather disparaging views of the importance of a didactic lecture, I am inclined to accept Dr. Weir Mitchell's* opinion that "The best lecturing does not so much think for you as invite you to think along suggested lines of enquiry." If, as has been claimed, "the passive attitude of listening does not demand of the students intelligent thought,"† the fault must lie with the lecturer and not with the method of instruction. In every department of medicine advanced instruction necessarily deals with subjects which lie within what Foster has called the 'penumbra' of solid scientific acquisition, and about which conflicting views are, therefore, certain to be held. It is in inviting thought, with regard to the evidence on which these views rest, that the experienced lecturer has his best opportunity to train the minds of his hearers. Other opportunities are also afforded by the historical presentation of subjects about which differences of opinion no longer exist, for there are few things more instructive than to follow up, step by step, the lines by which our knowledge has advanced, noting

* *The Michigan Alumnus*, Jan., 1900, Vol. VI., p. 143.

† *Philadelphia Medical Journal*, Oct. 21, 1899.

‡ SCIENCE, July 7, 1899.

* *University Bulletin*, Vol. III., p. 85. Phila., Dec., 1898.

† W. B. Cannon, A.M. The Case Method of Teaching Systematic Medicine. *Boston Med. and Surg. Journ.*, Jan. 11, 1900.

the marks which distinguish the paths which have been trodden successfully from those which have turned out to be 'No Thoroughfare.' Even better opportunities for mental training than those which the lecture room presents, are afforded by the recitation, for here the minds of the teacher and the pupil are brought most closely into contact, the pupil's difficulties are appreciated by the instructor, and the point of view of the teacher can be learned by the pupil. It has always seemed to me that no higher enjoyment falls to the lot of the teacher than that which he experiences when, by a series of carefully considered questions, he leads his pupil onward from the known to the unknown, and notes the gleam of intelligence which illumines his countenance as a subject, previously obscure, becomes clear, as a result of his own mental operations, guided by his teacher's skilful questions. It thus appears that no monopoly of opportunities for mental training can be claimed for the laboratory method of instruction.

We must next inquire: what are the relative advantages of the laboratory and didactic methods as means of imparting information? Here we at once perceive that a great deal will depend upon the kind of information to be imparted. Certain subjects are much better adapted than others to be taught in the laboratory. The student of anatomy, for instance, can secure the greater part of the information which he needs by laboratory methods, *i. e.*, in the dissecting room, though a short course of lectures on descriptive anatomy in which an experienced teacher emphasizes the salient features of the subject will probably always be indispensable. Physiology and pathology (including physiological chemistry, pharmacology and bacteriology) are subjects in which laboratory instruction may be unquestionably much more freely used than is customary at the present time. The recent experience of the Harvard Medical School, in which the laboratory courses in these subjects have been greatly extended, has furnished conclusive evidence of the value of this method of instruction as a means both of imparting information and of stimulating the mind of the student. It must be remembered, however, that, as Dr. Welch* has said, "laboratory methods are extremely time-taking and are not adapted to teach the whole contents of any of the medical sciences. It is, of course, hopeless to attempt to demonstrate practically all of even the more important facts that the student should learn."

Moreover, observed facts are often apparently inconsistent with each other. Equally competent observers differ in their interpretation of them. Yet, because the last word of science has not been spoken on these subjects, it would be a mistake to exclude them from the medical curriculum. The student should rather be carefully instructed as to researches which have not yet yielded definite results. The most profitable way of reconciling conflicting observations should be pointed out, and he should be shown in what direction the search for truth can be prosecuted with the best prospect of success. He will then be able to appreciate the value of new observations and to assign to their true position the reported discoveries in medical science.

Instruction of this sort can, of course, be given only by an experienced lecturer who has mastered the subject of which he treats. It is in this kind of teaching and in the exposition of those facts and principles which cannot properly be made the subject of laboratory instruction to students that the didactic lecture of the future will probably find its principal field of usefulness. In the latter direction, however, the field is

* Higher Medical Education and the Need of its Endowment. *The Medical News*, July 28, 1894.

more restricted than might, at first sight, appear for the amount of practical work that can be successfully performed by first- and second-year students in a physiological or in a pathological laboratory is surprisingly large. In the physiological department of the Harvard Medical School, for instance, during the current academic year each pair of students in a class of 180 has been furnished with a kymographion, a capillary electrometer, a moist chamber, an induction coil, unpolarizable electrodes, etc., and the most important experiments of nerve-muscle physiology have been successfully repeated. The fundamental experiments in the physiology of the circulation, respiration, etc., are to be performed in a similar manner. In the pathological laboratory the students, working in sections of ten, have had an opportunity of producing for themselves and studying experimentally the most important pathological degenerations. They have also studied in the same way the principal infectious diseases. In the anatomical department also, while the number of didactic lectures has been diminished, the whole class has had largely increased facilities for the practical study of bones and of various special organs.

Still, after making due allowance for the legitimate expansion of laboratory teaching, it is probably safe to say that a systematic course of lectures in each of the medical sciences will never be found to be superfluous and that the day is probably far distant when the lectures will be merely 'explanatory of the experiments.'*

We have thus far considered the relative advantages of didactic and laboratory methods in teaching the medical sciences, but the agitation in favor of objective teaching has extended also to the clinical departments of medicine and the organization of 'clinical laboratories,' in which the cases of hospital patients may be studied by the most refined methods of physiological and pathological research, is a natural outcome of this agitation. In fact, however, so far as instruction is actually given at the bedside, clinical medicine has always been taught by means of object lessons. In many of our schools this instruction has been supplemented by so-called 'conferences,' exercises in which a student reports before the class a case which he has himself examined, giving diagnosis, prognosis and treatment. The subject is then discussed by the class and finally by the instructors.

Wherever actual cases of disease are thus utilized for teaching purposes the instruction is always likely to be more or less haphazard and unsystematic, for the diseases studied will be those of which actual cases happen to be available. To remedy this difficulty it has been recently proposed * to substitute the study of hospital records of cases for the examination of the cases themselves, a method quite analogous to that known as the 'case-method' which has long been used with great success in training students in the Harvard Law School. It will thus be possible to group cases so that they will throw light upon each other and, though the student will miss the stimulus of contact with the actual patient, the method presents so many distinct advantages that it will doubtless commend itself to many teachers of clinical medicine and of theory and practice.

It is thus evident that the reaction against purely didactic methods of instruction is well under way. It is a movement to be heartily welcomed, for there can be no doubt that medical students have been and still are too much lectured, but, like all other reforms, it should be carefully guided lest useful as well as useless things be swept away. It should be borne in mind that it

* Porter, *Boston Med. and Surg. Journal*, Dec. 29, 1898.

* W. B. Cannon, A.M., l. c.

is quite as easy to abuse the laboratory as the didactic method of instruction and that in all schemes of education a good teacher with a bad method is more effective than a bad teacher with a good method. As Professor Howell * has well remarked, "courses of lectures, that, if analyzed would be found to be top-heavy and lopsided, and otherwise possessed of an instability that should have insured failure, have been saved and made instruments of great value by the mere earnestness of the teacher."

DISTRIBUTION OF WORK.

The next question which I shall ask you to consider is that of the proper distribution of the work of a medical student. Thirty years ago no such question seems to have presented itself to the minds of instructors in medicine. The medical faculties of that time contented themselves with providing, each year, courses of lectures covering all the departments of medicine, as they were then understood, and every student was expected to attend as many of the lectures as he saw fit. Between 1870 and 1880 the fact that there is a natural sequence in medical studies became generally recognized and graded courses of instruction were established in the principal medical schools of the country. The grading, was not, however, carried sufficiently far. Thus instruction in both anatomy and physiology was generally given simultaneously through the whole of the first year, though the knowledge of structure should logically *precede* a study of function.

The time seems now to have come for taking another step in grading medical instruction and, during the academic year now drawing to a close, instruction in the Harvard Medical School has been given in accordance with a plan of which the guiding principles are concentration of work and sequence of subjects. Thus in the first half of the first year the students devote themselves exclusively to the study of anatomy including histology and embryology. In the second half year they are occupied with physiology, including physiological chemistry, while in the first half of the second year pathology, including bacteriology, engages their attention. It is perhaps too early to pass a final judgment upon the value of the method but thus far both teachers and students seem to regard it as a success. The result seems to have justified the opinion of its advocates that the work of the student would be made 'easier by concentrating his thoughts upon one subject instead of dissipating his attention upon many subjects.'* Nor have its opponents found any justification for their fears that the average brain would become fatigued and unreceptive by too close application to one subject for the sciences of anatomy, physiology and pathology 'are not narrow hedged in areas but rather broad and diversified domains composed of many contiguous fields,'† in passing from one to another of which the student may rest his mind without interrupting the continuity of effort essential to effective work.

An obvious objection to this method of concentrating instruction is the large amount of work which it imposes upon the instructors. There is no doubt that the labor of teaching every day in the week may task the powers of even the most enthusiastic instructor, but it has been found that the laboratory work which has occupied from two to three hours every forenoon has been conducted with much less fatigue than was anticipated. In fact students, when supplied with printed directions for work and with the necessary apparatus, need remarkably little supervision. In the physiological laboratory it was found that one instructor could readily supervise

* l. c., p. 144.

* Minot, l. c., Reprint, p. 22.

† Porter, l. c., Reprint, p. 12.

the work of fifteen pairs of students, and the experience in the anatomical and pathological departments was of a similar sort.

EXAMINATIONS.

Closely connected with the questions of method of instruction and of distribution of work is the subject of examinations. With regard to these tests of our educational methods, opinions vary even more widely than with regard to the methods themselves. There is only one point, as Professor Exner has remarked, on which teachers are practically united, and that is, "that an examination is a necessary evil." Every examiner knows only too well that an examination is but a very imperfect test of knowledge, but few are ready with any suggestion of a substitute. Much of the confusion which prevails in the discussion of this subject would be removed if the objects to be secured by an examination were more clearly apprehended. Professor Exner* points out that examinations may be broadly divided into two classes, viz, the *Controlprüfung*, to test the faithfulness with which the student has performed his daily tasks, and the *Reifeprüfung* to determine the amount of his permanently acquired knowledge of medical subjects.

The examination, which, at the end of the year, covers the whole ground of the previous twelve months' instruction and which is so common in our schools, belongs to neither of these two classes and is really a concession to a very natural wish of the students to get the examination 'out of the way' while the subject is still fresh in their minds. Having little justification from an educational point of view we may hope to see it abandoned when the extension of laboratory methods provides in the notebook and graphic records of each student the evidence of his daily work, and thus either renders a further examination unnecessary or prepares the way for a final test of his fitness to receive his diploma of M.D. Whether the written or the oral examination affords the better method of applying this test is a question about which opinions vary. The fact that some persons can write more readily than they can talk, while others can talk more readily than they can write, seems to be a reason for providing a mixed method of examination in which each individual may have an opportunity of appearing to the best advantage.

* l. c., Reprint.

CONCLUSIONS.

If the views here presented are well founded we may expect that a medical school of the first rank will, in the immediate future, be organized and administered somewhat as follows:

I. It will be connected with a university but will be so far independent of university control that the faculty will practically decide all questions relating to methods of instruction and the personnel of the teaching body.

II. It will offer advanced instruction in every department of medicine, and will therefore necessarily adopt an elective system of some sort, since the amount of instruction provided will be far more than any one student can follow.

III. The laboratory method of instruction will be greatly extended, and students will be trained to get their knowledge, as far as possible, by the direct study of nature, but the didactic lecture, though reduced in importance, will not be displaced from its position as an educational agency.

IV. The work of the students will probably be so arranged that their attention will be concentrated upon one principal subject at a time, and these subjects will follow each other in a natural order.

V. Examinations will be so conducted as to afford a test of both the faithfulness

with which a student performs his daily work and of his permanent acquisition of medical knowledge fitting him to practise his profession.

If I have clothed these conclusions in the language of prophecy it is because the title of my discourse has laid this necessity upon me. In forecasting the immediate future, I have borne in mind the history of the immediate past and, if I have failed to read aright the indications of the lines on which our medical schools are to advance, it must be remembered that the development of a biological science and of its dependent arts not infrequently takes place in totally unexpected directions, thus introducing into the path of educational progress perturbations which may well defy prediction.

H. P. Bowditch.

Harvard Medical School.

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*NATIONAL STANDARDIZING BUREAU.**

Treasury Department,
Office of the Secretary,
Washington, April 18, 1900.

Sir: I have the honor to submit herewith the following draft of an amendment to the sundry civil bill, now pending in the Committee on Appropriations, and to recommend that the necessary appropriation to carry the same into operation and effect may be included therein:

That the Office of Standard Weights and Measures shall hereafter be known as the National Standardizing Bureau, and shall remain under the control of the Secretary of the Treasury.

The functions of the bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with the standards adopted or recognized by the Government; the construction when necessary of standards, their multiples, and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants, and the properties of materials when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

The bureau shall exercise its functions for the Government of the United States; for any State or municipal government within the United States, or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. All requests for the services of the Bureau shall be made in accordance with the rules and regulations herein established.

The officers and employees of the bureau shall consist of a director, at an annual salary of six thousand dollars; one physicist, at an annual salary of thirty-five hundred dollars; one chemist, at an annual salary of thirty-five hundred dollars; two assistant physicists or chemists, each at an annual salary of twenty-two hundred dollars; two laboratory assistants, each at an annual salary of fourteen hundred dollars; two laboratory assistants, each at an annual salary of twelve hundred dollars; one secretary, at an annual salary of two thousand dollars; one clerk, at an annual salary of twelve hundred dollars; one clerk, at an annual salary of one thousand dollars; one messenger, at an annual salary of seven hundred and twenty dollars; one engineer, at an annual salary of fifteen hundred dollars; one fireman, at an annual salary of seven hundred and twenty dollars; one mechanician, at an annual salary of fourteen hundred dollars; one mechanician, at an annual salary of one thousand dollars; one mechanician, at an annual salary of eight hundred and forty dollars; one watchman, at an annual salary of seven hundred and twenty dollars, and two laborers, each at an annual salary of six hundred dollars.

The director shall be appointed by the Presi-

* Letter from the Secretary of the Treasury, transmitting, with accompanying communications, a draft of a bill for the establishment of a National Standardizing Bureau.

dent, by and with the advice and consent of the Senate. He shall have the general supervision of the bureau, its equipment, and the exercise of its functions. He shall make an annual report to the Secretary of the Treasury, including an abstract of the work done during the year, and a financial statement. He may issue, when necessary, bulletins for public distribution, containing such information as may be of value to the public or facilitate the bureau in the exercise of its functions.

The officers and employees provided for by this act, except the director, shall be appointed by the Secretary of the Treasury, at such time as their respective services may become necessary.

The following sums of money are hereby appropriated: For the payment of salaries provided for by this act, the sum of thirty-four thousand nine hundred dollars, or so much thereof as may be necessary; for the erection of a suitable laboratory, of fireproof construction, for the use and occupation of said bureau, including all permanent fixtures, such as plumbing, piping, wiring, heating, lighting, and ventilation, the sum of two hundred and fifty thousand dollars; for equipment of said laboratory, the sum of twenty-five thousand dollars; for a site for said laboratory, to be approved by the visiting committee hereinafter provided for and purchased by the Secretary of the Treasury, the sum of twenty-five thousand dollars, or so much thereof as may be necessary; for the payment of the general expenses of said bureau, including books and periodicals, furniture, office expenses, stationery and printing, heating and lighting, expenses of the visiting committee, and contingencies of all kinds, the sum of ten thousand dollars, or so much thereof as may be necessary, to be expended under the supervision of the Secretary of the Treasury.

For all comparisons, calibrations, tests, or investigations, except those performed for the Government of the United States or State governments within the United States, a reasonable fee shall be charged, according to a schedule submitted by the director and approved by the Secretary of the Treasury.

The Secretary of the Treasury shall from time to time make regulations regarding the payment of fees, the limits of tolerance to be attained in standards submitted for verification, the sealing of standards, the disbursement and receipt of moneys, and such other matters as he may deem necessary for carrying this act into effect.

There shall be a visiting committee of five members, to be appointed by the Secretary of the Treasury, to consist of men prominent in the various interests involved, and not in the employ of the Government. This committee shall visit the bureau at least once a year, and report to the Secretary of the Treasury upon the efficiency of its scientific work and the condition of its equipment. The members of this committee shall serve without compensation, but shall be paid the actual expenses incurred in attending its meetings. The period of service of the members of the original committee shall be so arranged that one member shall retire each year, and the appointments thereafter to be for a period of five years. Appointments made to fill vacancies occurring other than in the regular manner are to be made for the remainder of the period in which the vacancy exists.

I transmit herewith a statement of the conditions which call for the establishment of a national standardizing bureau, together with a few of the resolutions adopted by scientific bodies and the opinion of individuals as to the immediate and urgent need of such an institution.

Respectfully,

L. J. GAGE,
Secretary.

THE SPEAKER OF THE HOUSE OF REPRESENTATIVES.

CONDITIONS WHICH NECESSITATE THE ESTABLISHMENT OF A NATIONAL STANDARDIZING BUREAU.

The selection and care of the original standards, and the solution of problems involved in the production, calibration, and distribution of duplicates, constitute one of the most important branches of scientific work any government is called upon to undertake. That such work should in all cases be under the control of the General Government, and that general governments

should co-operate with each other in establishing uniformity of standards, is a fact usually admitted as beyond dispute. Until recent years this work has been confined to problems concerned with the standards of length, mass, capacity and temperature; but the increased order of accuracy demanded in scientific and commercial measurements and the exceedingly rapid progress of pure and applied science have increased the scope of such work until it includes many important branches of physical and chemical research, requiring for its successful performance a complete laboratory, fitted for undertaking the most refined measurements known to modern science.

Germany has established the Physikalische-Technische Reichsanstalt and the Normal-Aichungs-Commission; England, the Standards Department, the Electrical Standardizing Laboratory, and the National Physical Laboratory (but recently established); Austria, the Normal-Aichungs-Commission; and Russia, the Central Chamber of Weights and Measures. These, together with the institutions of other countries and the International Bureau des Poids et Mesures, at St. Cloud, France, are organized for the purpose mentioned and are noted for the very important work they accomplish annually. An examination of the function of these institutions and the sums of money devoted to their maintenance is the most convincing evidence of the importance of problems pertaining to standards and standard-measuring apparatus.

Throughout our country institutions of learning, laboratories, observatories and scientific societies are being established and are growing at a rate never equaled in the history of any nation. The work of original investigation and instruction done by these institutions requires accurate reliable standards, which in nearly every case must be procured from abroad, or can not be procured at all.

The extension of scientific research into the realm of the extremes of length, mass, time, temperature, pressure and other physical quantities necessitates standards of far greater range than can be obtained at present. Frequently the comparison of the same physical quantities vary with the magnitude of the quantity to be measured, and may even introduce entirely new conditions, methods and apparatus, as in the case of high or low temperatures.

The introduction of accurate scientific methods into manufacturing and commercial processes involves the use of a great variety of standards of far greater accuracy than formerly required. An accurate knowledge of the high temperature of a furnace or refinery, or the low temperature of a refrigerating process, is often essential to the economical working of the process.

Enormous commercial transactions are daily based upon the reading of electrical measuring apparatus, inaccuracies of which involve great injustice and financial losses; hence the national bureau should be in a position to calibrate or test electrical standards of all kinds for commercial, as well as the most refined scientific work.

The scientific work carried on by the different departments of the Government involves the use of many standards and instruments of precision, which are too frequently procured from abroad, owing to our own lack of facilities for standardizing.

The manufacture of scientific apparatus and instruments of precision has been confined almost exclusively to foreign countries, but at present is growing at a rate which will soon place our own production on a par with that of any other country. In order to secure the requisite degree of uniformity and accuracy it is absolutely essential that American manufacturers of such apparatus have access to a standardizing bureau equivalent to that provided for the manu-

facturers of other countries, notably Germany and England.

The recent acquisition of territory by the United States more than proportionately increases the scope and importance of the proposed institution, since the establishment of a government in these possessions involves the system of weights and measures to be employed. During the near future large public improvements will be undertaken in these countries; schools, factories, and other institutions will be established, all of which require the use of standards and standard measuring apparatus.

Ample facilities should be provided for the investigation of problems which arise in connection with standards and standard measuring apparatus, since it is by the solution of these problems that the standardizing department is enabled to meet the demands of modern and improved methods of measurement.

The work of the Office of Standard Weights and Measures has been of a high order, and as extensive as the appropriation, working force, and quarters would permit; but in view of its great importance to scientific and commercial interests, it is earnestly requested that its functions be enlarged to meet the requirements of existing conditions, and that it be provided with a suitable laboratory, equipment and working force.

NATIONAL ACADEMY OF SCIENCES,
Washington, D. C., April 19, 1900.

SIR: In response to your request and by authority of the National Academy of Sciences I have the honor to communicate the following resolution, adopted by the Academy at its present session:

"Whereas the facilities at the disposal of the Government and of the scientific men of the country for the standardization of apparatus used in scientific research and in the arts are now either absent or entirely inadequate, so that it becomes necessary in most instances to send such apparatus abroad for comparison: Therefore, be it

"*Resolved*, That the National Academy of Sciences approves the movement now on foot for the establishment of a national bureau for the standardization of scientific apparatus."

I am, sir, yours, with great respect,

WOLCOTT GIBBS,
President.

THE SECRETARY OF THE TREASURY,
Washington, D. C.

STATISTICS RELATING TO STANDARDIZING INSTITUTIONS OF FOREIGN GOVERNMENTS.

England.

Standards Department.—Established in 1879, to provide for the custody of the standards; to construct and verify copies of the standards; to verify standards in use by local authorities; to regulate the system of inspection in use in the Empire. Under board of trade. Work directed by a superintendent of weights and measures.

Total annual expenses, including salaries, equipment, and incidental expenses for the year 1897-98. ..... $15,700

Electrical Standarizing Laboratory.—Established 1890, for general electrical testing and the verification of electrical standards and measuring apparatus. Situated at Old Palace Yard, Westminster. Under board of trade. Work directed by a chief electrician.

Total annual expenses, including salaries, equipment, and incidental expense for the year 1897-98..... $8,600

Kew Observatory.—Established 1871, at Old Deer Park, Richmond, Surrey. Originally founded as an astronomical observatory; then as a meteorological observatory; now as a general testing bureau. Under Royal Society of London. Affairs controlled by the Kew Observatory committee. Work directed by a superintendent. Recently incorporated in the National Physical Laboratory.

Total annual expenses, including salaries, equipments, and incidental expense for the year 1897-98 (almost wholly derived from fees)..... ..... $17,800

National Physical Laboratory.—Established 1899, to be situated at Old Deer Park, Richmond, Surrey. To be a general standardizing laboratory where standards and measuring instruments in use in science or in trade may be verified. Research work may be undertaken when required for the needs of the laboratory or regarded as of distinct value to the public generally. To this institution will be added the buildings, grounds, equipment, and income of the Kew Observatory, thus placing the latter institution under the general head of government institutions. Work to be controlled by a committee of leading scientists, and under immediate control of a director.

Annual appropriation, 1900–1901, for salaries, equipment, and incidental expenses (above the income of Kew Observatory)..... $20,000

Germany.

Die Normal Aichungs Commission.—Established 1868, at Berlin, to regulate the system of inspection of weights and measures throughout the North German Confederation; to construct and provide standards and the necessary measuring apparatus for the local bureaus; to fix regulations in regard to the system of inspection, and to provide for the safe custody of the standards. Under the immediate supervision of a director, aided by the commission, which is composed of scientific men who have been connected directly or indirectly with matters pertaining to weights and measures. Two hundred and fifty thousand dollars was appropriated in 1899 for new buildings and equipment.

Total annual expenses, including salaries, equipment, and incidental expenses for the year 1897–98..... $36,000

Die Physikalische-Technische Reichsanstalt.—Established 1887, at Charlottenburg, as a national physical laboratory and standardizing bureau. Under the control of a president, with an advisory board or council of scientific men. The total appropriations to date for buildings, grounds, and equipment amount to over $1,000,000.

Total annual expenses, including salaries, equipment, and incidental expenses for the year 1897–98..... $80,000

The Reichsanstalt is organized in two sections, as follows:

Section I.—The execution of physical investigations and measurements which aim at the solution of scientific problems of great importance, which require a greater outlay of time, equipment, and materials than are at the disposal of institutions founded primarily for educational purposes. The work of the section also includes the solution of such scientific problems as may arise in connection with the work of Section II.

Section II.—(1) The execution of physical or technical investigations, as required by the Government, or which are of such a character as to further the interests of German manufacturers of instruments of precision, and other branches of technological work, such as the determination of the physical properties of materials, the preparation of materials, the best methods of construction for technical and measuring apparatus.

(2) The verification and calibration of measuring instruments and standards of reference not provided for by the Aichungs Commission.

(3) The construction of instruments, or parts of instruments, and the execution of the mechanical work needed in connection with the equipment and investigations of the institution, and for other bureaus of the Government, so far as such work cannot be afforded by private workshops.

(4) The execution, in special cases, of work similar to that mentioned in (3) for German manufactures.

The Reichsanstalt is reimbursed for work performed in accordance with (3) and (4)

upon the basis of the cost of material and double the time employed.

Austria.

Normal Aichungs Commission.—Established at Vienna in 1871, upon the adoption of the metric system by Austria; to exercise a technical control over the inspection of weights and measures throughout the Empire; to establish regulations regarding inspection; to fix the limits of tolerance; to provide for the custody of the standards; to construct and verify copies of the standards; and to equip the local inspection bureaus with copies of standards and measuring apparatus; to verify, for institutions and individuals, standards and measuring apparatus submitted. The commission is subordinate to the Minister of Commerce, and is composed of a director and a number of co-ordinate members. The director is empowered to appoint a suitable force of technical clerical assistants.

Total annual expenses, including salaries, equipment, and incidental expenses for the year 1897–98	$46,000

Russia.

Central Chamber of Weights and Measures.—Established 1878, at St. Petersburg, reorganized 1893, to exercise control over all systems of weights and measures in use in the Empire. The work at present is largely preliminary, and comparisons are confined to standards of length, mass, and capacity, but it is the intention of the Government to include the comparison of thermometers, barometers, hydrometers, alcoholometers, etc., and electrical measuring apparatus. Experiments in most of these branches are now being conducted in the laboratories of the chamber, and results of extreme precision are now being obtained, under the minister of finance and the supervision of a director. One hundred and seventy-five thousand dollars was originally appropriated for buildings and grounds.

Total annual expenses, including salaries, equipment, and incidental expenses, for the year 1897–98	$17,500

The total amounts annually appropriated by different governments for standardizing purposes are as follows:

Germany	$116,000
England	62,100
Austria	46,000
Russia	17,500
United States	10,400

A NEW ENZYME OF GENERAL OCCURRENCE IN ORGANISMS.

A PRELIMINARY NOTE.

WHILE occupied with investigations on the enzymes in the tobacco leaf the writer observed that the clear filtered juice of the fresh leaf, although giving strong reaction for oxidase and peroxidase, yields but a very weak reaction with hydrogen peroxid, *i. e.*, develops mere traces of oxygen upon addition of this substance. The *unfiltered* juice, however, containing in suspension protein matter, chlorophyll bodies, starch granules, etc., yields a very energetic development of oxygen. This behavior caused the writer to doubt the correctness of the now generally adopted teaching that the power of catalyzing hydrogen peroxid is a property of all enzymes. The known enzymes are soluble in water and although they can be retained in a certain measure by some suspended matters, the difference of behavior of the unfiltered and filtered juice in the case just mentioned could hardly be so very marked.

Further tests have shown the writer that the power of catalyzing hydrogen peroxid is found also in manufactured tobacco which had been air-cured, while flue- or fire-cured tobacco was generally indifferent in this regard. Air-cured tobacco that was subjected to a subsequent 'sweating in bulk' shows this power often in a high degree although it is impossible to find the common enzymes. Even oxidase and peroxidase may be destroyed in the sweating process, without the loss of this catalytic power.

Further tests have revealed the fact that various enzyme preparations of commerce, as emulsin, papain, trypsin, may have no trace of the power of catalyzing hydrogen peroxid and nevertheless be very powerful in their specific actions, and it is evidently only due to another substance of enzyme nature present as an impurity when the common enzymes exhibit that catalytic power on hydrogen peroxid. This specific substance occurs in an insoluble and in a soluble form. The former seems to be a compound of the latter, a kind of albumose, with a nucleo-proteid. There seems to exist no plant and no animal which is without that peculiar enzyme, which the writer proposes to name *catalase* from its catalytic action on hydrogen peroxide. It belongs to the group of the oxidizing enzymes.*

In aqueous solution this enzyme is 'killed' between 72° and 75° C. Its action on hydrogen peroxide is retarded by certain salts, especially nitrates of the alkaline metals, and stimulated by others, as sodium carbonate.

One of the functions of this enzyme appears to be to prevent any accumulation of hydrogen peroxid which might be formed as a by-product in the series of energetic oxidations that characterize the cellular respiration process. Hydrogen peroxid is a poison for the living protoplasm, hence the activity of catalase is of vital importance. Recent investigations of Eugen Bamberger and also of Manchot leave no doubt that hydrogen peroxid is generally produced in the process of autoxidations of many labile organic compounds when exposed to air.

A detailed investigation of catalase will be published in a special Bulletin of the U. S. Department of Agriculture.

Oscar Loew.

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*It also plays a rôle in the 'sweating' process of tobacco.

THE RECENT ANNUAL RECEPTION AND EXHIBITION OF THE NEW YORK ACADEMY OF SCIENCES.

The seventh annual reception of the New York Academy of Sciences took place April 25th and 26th, at the American Museum of Natural History. A beautiful and spacious hall on the main floor in the east wing was assigned by the Museum authorities and proved admirably adapted for the purpose. The several branches of science were in charge of the following specialists, who together made up the general committee:

Anthropology, Franz Boas.
Astronomy, J. K. Rees.
Botany, D. T. MacDougal.
Chemistry, C. E. Pellew.
Electricity, Geo. F. Sever.
Geology and Geography, R. E. Dodge.
Metallurgy, H. M. Howe.
Mineralogy, L. McI. Luquer.
Paleontology, Gilbert van Ingen.
Physics and Photography, Wm. Hallock.
Psychology, Edw. L. Thorndike.
Zoology, Charles L. Bristol.

In the section of Anthropology, some of the interesting collections of the Jesup and Huntington expeditions to the northwest coast were shown. They illustrated designs in gold from the Amoor river; the archæology of the coast of southern British Columbia, including jade implements from graves, that were very striking; and implements of the Eskimo of Southampton Island. In addition, symbolism among the Arapahos received attention, and basketry work from California was well represented. In the section of Astronomy the work of many observatories was exhibited through the courtesy of their Directors. The Lick observatory showed photographs of nebulæ; the Lowell observatory at Flagstaff, Arizona, its recent work on planets and satellites; the University of Pennsylvania, its results with the zenith telescope; Sir Norman Lockyer, his enlargement of the spectrum of Alpha Cygni,

and the Columbia University observatory various lines of recent work.

The Botanical section contained many individual exhibits and others which specially illustrated recent progress at the New York Botanical Garden. Many preparations were shown with microscopes. Professor Geo. E. Stone, of the Massachusetts Agricultural College, had one series of apparatus that he had used in the study of plant physiology, and that attracted especial attention. Under Chemistry the new synthetic indigo and numerous artificial perfumes drew the attention of many visitors, while recently developed apparatus and preparations interested others. At the tables devoted to Electricity many new and improved forms of apparatus were shown. In the section of Geology and Geography, the U. S. Geological Survey gave a very full exhibition of its recent maps and publications, all of which aroused much interest and many inquiries. The work of the Maryland Geological Survey and Weather Service was admirably presented and received very favorable comment.

Metallurgy appeared this year for the first time, and was especially rich in illustrations of Metallography, as developed in the School of Mines at Columbia University. New varieties of steel; various metals, more or less rare; alloys; by-products and refractory materials gave many visitors an opportunity to see objects seldom exhibited. Under Mineralogy, the greater number of the new minerals described during the year were shown, and many superb specimens of older ones. Of especial interest was a series of 51 specimens of American tellurides, shown by Professor A. H. Chester, of Rutgers. The Egleston Museum of Columbia University displayed both minerals and apparatus. In Paleontology, the most interesting exhibits were the recent collections of vertebrates from the West by the parties of the American Museum. The remarkable find of five complete skeletons of the last extinct horse of North America (*Equus occidentalis*), which was previously known only in scattered individual bones, excited the liveliest interest. In addition, a camel that possessed many features of the giraffe, and complete mounted skeletons of *Oxyaena* and *Patriofelis*, together with many other fine specimens, gave visitors an idea of the remarkable progress of the Museum in this branch. The members of the Academy were gratified to note that Mr. Charles Knight is continuing his restorations, two new ones being shown, viz, *Tylosaurus* and *Megaceros hibernicus*. A valuable collection of fossil fish recently acquired by the American Museum, from Ohio, was also shown through the courtesy of Professor Whitfield.

Under physics and photography, Dr. P. H. Dudley exhibited further results of his observations upon strains in rails under moving trains by means of the 'stremmatograph,' his valuable and ingenious instrument, invented for this purpose. The great advantage of heavy and stiff rail sections was clearly proved. Photographs in color by means of diffraction gratings, and kinetoscope projections of the motion of a wave, both by Professor R. W. Wood of the University of Wisconsin, excited great interest. In addition many other forms of ingenious apparatus received careful attention from visitors. In the section of psychology the chief exhibits consisted of new forms of apparatus. One, by Professor Cattell, projected simultaneously upon a screen, by means of the lantern, a time scale, a curve of breathing and another of pulsation, both while being produced by a person, engaged in any prescribed occupation. This received especial attention from visitors.

On the tables devoted to zoology the visitor saw a beautiful series of photographs illustrating progress at the new Zoological Garden of New York, and few, not familiar

with the facts, were prepared for the results displayed. Many preparations of an anatomical nature were exhibited by others, and many of an embryological character, oftentimes under the microscope, attracted deep interest. A series of beautifully mounted heads of venomous and non-venomous snakes, by R. L. Ditmars, gave an excellent idea of their differences in dentition and structure.

On the whole, the exhibition maintained the high standard established in former years and gave instruction and pleasure to between two and three thousand members and their friends. Every possible courtesy was extended by the officers of the American Museum, and the Academy is again placed under a debt of gratitude to them. Our thanks may also be expressed in this place to the many friends whose contributions made the exhibition a success, and of whom only a small part could be specially mentioned above.

J. F. Kemp,
Chairman of Committee.

SCIENTIFIC BOOKS.

The International Geography. By Seventy Authors; edited by Hugh Robert Mill, D.Sc. New York, D. Appleton & Company. 1900. Pp. 1088, with 488 illustrations.

The International Geography is a large, single volume compendium of geography, rightly named international, both from the standpoint of scope, and from that of authorship. The seventy authors who have co-operated in the enterprise have been chosen from all parts of the world, each to write on his own specialty, so that the editor has secured the most eminent help possible in each of the chapters of the book. We find, for instance, that Sir John Murray contributes a chapter, with the Editor, on the ocean; Professor Penck, a chapter on the Austro-Hungarian Monarchy; and Mr. H. O. Forbes, a chapter on the Malay Archipelago, all of which are but random illustrations, that are typical of the work as a whole.

The volume is divided into two parts, the first, of 122 pages, devoted to the Principles of Geography, and the second, of 930 pages, to Continents and Countries. In the second part, each of the continents is considered in detail by countries, and special chapters are devoted to the Polar Regions. The volume closes with an accurate, inclusive, and very satisfactory index, covering 35 pages.

One reviewer has stated that perhaps no one but the editor was personally qualified to review adequately such an inclusive and complete summary of the present geographical conditions of the world, a remark with which many of us will perhaps agree. No complete analysis is, therefore, contemplated here; but attention will be given to certain special features of the volume, first, as to its general usefulness, and second, as to the special chapters on the United States and North America.

The present reviewer feels that the volume under consideration ought to be of every day use to nearly every advanced teacher of geography in grammar schools, and to every trainer of future geography teachers in normal schools and colleges, and has introduced the volume with satisfactory results in one large class of school teachers studying geography. In this volume teachers and all others who have need of getting quickly in touch with the best in reference to all countries, find that best, told concisely, interestingly, clearly and effectively. Supplied with a good atlas and this volume, any teacher is well equipped as to opportunity for securing the best information for daily use. One of the particularly valuable features of the book is that it is adapted to the abilities of the audience to which it would appeal. The editor and the authors are to be congratulated in that they did not miss their mark.

The special chapters dealing with America were written by Professor W. M. Davis, and Mr. J. B. Tyrrell, formerly of the Canadian Geological Survey; Professor Davis writing on North America as a whole, and Mr. Tyrrell on the Dominion of Canada. In the chapter on North America, Professor Davis starts out with certain comparisons between North and South America, and between North America and Eurasia. Following this is a consideration

of the Coast Lines; the Laurentian Highlands; Glacial Action; the Appalachians; Rocky Mountain System; the Great Plains; Climate; Rainfall and Vegetation; Aboriginal People; and History. The plan followed in reference to the United States is characterized by the editor as novel, and 'perhaps the most instructive in the book.' Surely it is not too much to say that in the sixty-three pages devoted to the United States we have the best existing summary of the present geographical features of our Republic, causally considered. In the regional description of the United States the area is divided into physical provinces, and in each the effect of the physical features in shaping or determining the social and economic conditions in the present or past is well brought out, and so skillfully done that the political phase seems a necessary part of the physical phase, as is, perhaps, best shown in the section on New England.

The chapter is accompanied by an outline map of the United States, which is particularly graphic and usable. It will be noted from the map that the author's division of the United States into physical divisions differs very materially from the divisions previously published by our workers in geomorphology. The scheme here used is simple and accurate, and equally well suited to those who know the several regions personally, and to those who do not. This chapter should be read by all who desire a clear, interesting, and faithful account of the United States.

As a whole, the volume deserves a place among the necessary reference books, at ready call in all libraries, public and private. There are few inaccuracies and few typographical errors; the book being printed in a pleasing and attractive manner on paper that, though thin, is good, so that the volume is not unwieldy in spite of its length. This volume will, undoubtedly, be the standard one volume reference book for years to come, and the editor deserves great praise for his skill and care in carrying to successful completion a complicated and difficult enterprise.

RICHARD E. DODGE.

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A Manual of Psychology. By G. F. STOUT, M.A., LL.D. London, University Correspondence College Press. 1899. Pp. 643.

The psychological world has been anticipating this book with lively interest since the appearance of the author's *Analytic Psychology* in 1896. In the preface to that work Dr. Stout writes as follows: "When I first planned the present work, it was my intention to follow the genetic order of treatment. But I found myself baffled in the attempt to do this without a preparatory analysis of the developed consciousness. * * * I therefore found myself driven to pave the way for genetic treatment by a previous analytic investigation; and the result was the present work. It must, therefore, be regarded, even in respect to my own plan of procedure, as a fragment of a larger whole. * * * I may say that my strongest psychological interest lies in certain genetic questions, and especially in those on which ethnographic evidence can be brought to bear." In judging the *Manual*, then, one must keep in mind its predecessor which is, in a certain sense, also its complement. It is, however, necessary to observe, at the same time, the distinct offices of the two works. The first is a general, systematic treatise; "its aim is to bring systematic order into the crowd of facts concerning our mental life revealed by analysis of ordinary experience:" the second is a text-book. Many divergences in the two which one is inclined, at first sight, to lay to a change in standpoint are undoubtedly to be ascribed rather to a difference in the manner of exposition.

There is no doubt that the wave of psychological enthusiasm which has been advancing so steadily for a quarter of a century is tending to eddy into a series of specific, but profound interests. The change is natural; it might have been read beforehand from the history of any one of the older disciplines. Systematic thinking reorganizes itself by concentrating at critical points, as really as does matter by the redistribution of its functions. Just now one of the currents of psychological thought is flooding towards the genetic center of activity. Is it not time, many psychologists are asking, to construct a paleontology of consciousness upon the basis of collected fragments? Can we

not read out of the successive strata of mind the distinctive features of an eopsychic, a meso-psychic, and a cenopsychic period? The best answer to these questions at present (and the best is poor) is given in the few comprehensive attempts really to write genetic psychology. I say 'few' because so much of the mass of what is called genetic work has been built upon a generous and sympathetic interest in brutes and infants instead of upon firm psychological principles, and has simply washed away.

These are some of the circumstances which make the present volume so sincerely welcome at the door of psychology. It comes from a pen which has already traced its way through the intricacies of the problems of the developed human consciousness under the lead of the whole English school of psychological thought.

What the author understands by the genetic method is clearly stated in the preface to the 'Analytic' volumes. Stout says: "What is called the genetic or synthetic method, instead of attempting merely to ascertain and define the processes of the developed consciousness as we now find them, proposes to itself the task of tracing the evolution of mind from its lowest to its highest planes." Let us see how the program has been carried out in the *Manual*.

The general arrangement of the book is very much like that of the *Analytic Psychology*. Each has a number of introductory sections on the scope and methods of psychology, followed by a 'general analysis,' and this, in turn, by a discussion of mental processes. But here the similarity ceases. The earlier work deals largely with matters of methodology and of psychological theory; filling out what Kant would call the architectonic of the science; while the *Manual* deals directly with its subject-matter. Since it is more concrete and less formal, the genetic volume approaches much nearer the actual mind of experience. After the ground has been cleared, three stages in the development of mind, the sensational, the perceptual, and the ideational, are treated in turn and furnish material for the main divisions of the work.

It is to be noticed at the outset that the mind with which the *Manual* deals is the knowing and doing mind. "Psychology," we read, "is the science of the processes whereby an individual becomes aware of a world of objects and adjusts his actions accordingly." And again, "psychology finds a certain world of objects presented, let us say, to an educated Englishman of the 19th century, and it inquires how this world has come to be presented. * * * The world of the young child, or the world of the Australian aborigine, are comparatively primitive formations; and the psychological problem is to discover how the transition has been made from these earlier stages to the later stages with which civilized adults are now familiar." The author, following Ward, makes the *presented object* the important datum for psychology: "except in the case of pure sensation," we read, "none of these processes (sensation, perception, attention, volition, etc.) can either exist or be conceived apart from a presented object." And, "the development of an individual mind is at the same time the development of the objective world as presented to that individual mind." That is, the problem of psychology as it appears to Stout is the *functioning* of mental processes: 'how does mind make its world?' rather than 'what processes at this or that level of development exist as processes in consciousness?' It is rather the efficiency of the machine than its construction that is investigated.

We may arrive at the same point from another direction. The author's 'ultimate modes of being conscious' are those which are marked out in the *Analytic Psychology*. They are the cognitive attitude, the feeling attitude, the conative attitude. These are all, notice, attitudes toward an object; they all depend upon the presentation of an object. Hence, the reference of consciousness beyond itself is kept constantly in the foreground.* Modes of being conscious resolve themselves into 'modes of being conscious of an object.'

For the cognitive experience the author retains Ward's 'presentation' using it, however,

*One exception is made: sensation is defined as conscious event (though it was said earlier that sensation could not be conceived apart from a presented object), but the author soon gets from this into cognition through the sensation reflex.

in a more limited sense (barring motor presentations). The feeling attitude implies that we are 'pleased or displeased, satisfied or dissatisfied with' an object. The term is broader than feeling-tone—which is a 'generic word for pleasure and pain'—since emotion involves unique and irreducible feeling attitudes. Finally, the peculiarity of the conative attitude is the "inherent tendency [in mental states] to pass beyond themselves and become something different. It is the teleological drift of consciousness; it has a positive phase, 'appetition' and a negative 'aversion.' Conation includes attention as a special case. "Attention is simply conation in so far as it finds satisfaction in the fuller presentation of its object, without actual change in the object." After discussing these ultimate modes, the 'primary laws of mental process' are given. These laws formulate the manner of going-along and going-together of processes. The chapter includes a group of apparently heterogeneous topics; relativity, conative unity and continuity, retentiveness, association, reproduction, acquirement of meaning, facilitation and arrest, habit and automatism, and physiological dispositions. The coherence of the chapter is in several places, doubtful. The most important point in the chapter, both from a genetic and an analytic point of view is, in the writer's opinion, the exposition of 'cumulative dispositions': the effect, that is, of an earlier upon a later consciousness without the reinstatement of the earlier experience. It is the problem that Spencer grappled with, by no means successfully, in his general law of association, and one which very much needs working out in detail.

The general analysis closes with a clear, concise statement and criticism of 'faculties' and 'associationism.' The opening of Book II. brings the student to the real subject matter of the science. This Book, which covers about the same number of pages as the preliminary chapters, is occupied with sensation. Sensation is, for the author, a 'special form of consciousness' produced by some condition outside the nervous system, *i. e.*, a stimulus. On account of differences in intensity, steadiness, etc., the 'sensory elements' in images are not included in sensation. Sensations are dealt with in psychology both as 'psychological states' and as 'vehicles of knowledge.'

It is to be noted that sensation is not always treated here as an abstraction; for it is maintained that 'mere sensation' exists concretely even in adult experience. This is an important point, because Stout's genetic scheme, as developed later, assumes that sensation is not necessarily something totally distinct from a cognized object or any bit of cognition, as experimental psychology insists, but a concrete kind of consciousness which forms the initial member in the genetic series.

The 'sensation reflex' (a self-contradictory term!) it is which emerges above the physiological reflex and becomes 'the most primitive form of mental life which is distinctly recognizable.' The physiological reflex passes into the sensation reflex (1) when a special emergency arises, as coughing, *e. g.*, and (2) when the mind is not too much pre-occupied by higher processes. A meagre enough *raison d'être* for consciousness? Apart from the difficulty of tacking consciousness on to a complete and efficient physiological mechanism, there is the question why a consciousness thus added should be the same in kind as an ultimate element of the developed consciousness, *i. e.*, sensation. Is it not more likely, as Ebbinghaus remarks (*Grundzüge der Psychologie*, Vol. I., p. 10) that the original consciousness was, like the derivative one, a complex, not a wholly simple one? Stout partly saves himself from confusing an analytic and a genetic simple by endowing the sensation reflex with both 'conative' and 'hedonic' attributes; it may include appetition or aversion, and pleasure or pain. But with these endowments does not the sensation reflex really become an *impulse*, and would not the type of consciousness be better described as impulsive than as 'purely sensational'? The author does, in fact, go so far as to call it incidentally a 'sensational impulse.' Surely, a better term, especially since he lays so much emphasis on the teleological aspect of consciousness.

With this chapter on the primitive consciousness is started the genetic plan. As experience develops raw sensation becomes less and less, meaning, significance becomes more and more;

the perceptual consciousness becomes relatively more prominent, while "sensation is more delicately differentiated, more definitely restricted, less intense, and less strongly toned in the way of pleasure or pain." At the same time—and this is very important for the author's functional standpoint—differentiation means a less immediate reaction and a more clever planning for remote ends. Beyond these general statements and a hint at the corresponding development of organs, the *Manual* is decidedly disappointing in its treatment of differentiation; a concept which Spencer handled so boldly, when there was a paucity of knowledge on the subject, and which James and Ward have since made promising, but have not worked out.

We pass rather suddenly from these general synthetic questions to a detailed study of the various senses. A chapter is given to vision, one to audition, one to 'Other Sensations,' one to the 'Weber-Fechner Law'—a summary of Meinong—and a final one to the 'Feeling-tone of Sensation.' We cannot stop to point out many things that are admirable both in selection and in arrangement, or to indicate possible lines of criticism. There is, on the whole, a general suggestion of perfunctoriness in this part of the work. The material used shows the traces of second handling; it is, however, for the most part from reliable sources (chiefly Ebbinghaus and Foster), and is brought down to date. We find occasional lapses in the strict use of sensation; for example, we read of the 'sensation of softness and smoothness,' 'position-sensations and movement-sensations' and, finally, sharpness and bluntness, hardness and softness, wetness and dryness are spoken of as 'peculiar qualities of sensation.' Surely a gross confusion of sensation and perception, which is defined as 'the cognitive function of sensation.' Another difficulty arises in connection with the feeling-tone of sensation. It was remarked earlier that feeling-tone, including pleasure and pain, is one of the feeling attitudes; but here we find a whole chapter under sensation devoted to feeling-tone. Now, if feeling-tone is an ultimate mode of being conscious, how can it be a feeling-tone of sensation, *i. e.*, a variable dependent upon sensation which is not an ultimate mode of consciousness?* If, in other words, feeling-tone is a feeling-attitude and demands relation to an object, how can it be the feeling-tone of sensation which abstracts from the object? Still, we are told that feeling-tone does exist on the level of 'mere sensation.' The confusion, in both cases, evidently arises from the failure to keep distinct the architecture of mind and the offices it fulfils as interagent between the organism and the objects which it knows. It is to be remarked that, in the sensation chapters, the genetic standpoint is almost entirely forsaken. This is somewhat surprising, since sensation was the datum from which the phylogeny of mind was started. It is, again, the sensation abstracted from the introspected consciousness at odds with its *alter ego*, the sensation of genesis. In view, then, of the confusion which necessarily pervades this section and of the obvious shift of standpoint, one is tempted to remark that the work would have gained rather than lost by the omission of most of the chapters on Sensation.

The third and fourth books, on Perception and Ideation, respectively, are much more satisfactory than the Sensation chapters. An admirable introductory chapter to the third book gives the characteristics of the perceptual consciousness. Perception is the cognitive function of sensation, but it has also a conative aspect and a feeling-tone; it is not only reference to an object, but it is an active striving toward, and striving implies feeling. The Perception chapters breathe the spirit of that wholesome conservatism which has recently been infused into genetic psychology. It is clear that the author has a program worked out, and worked out on the basis of facts rather than from logical formulæ. Two things are insisted upon: first, the categories of the developed consciousness must not be thrust upon the primitive mind, and, secondly, the activity of the organism must be reckoned with in mental development; the individual is not to be regarded as an inert mass that draws in the world by a kind of mental attraction: he learns by doing

* We may even go deeper than this and ask how the genetic series can be started, at all, with something which is not an ultimate mode.

—whatever 'doing' may mean in psychological terms.

Imitation receives scanty notice. Emotion is more adequately treated; still, one is surprised to find the genesis of emotive states so little dwelt upon. The opportunity for giving a valuable account of the history of emotion has not been seized. The last part of Book III. is devoted to special percepts and includes Perception of External Reality, of Space, and of Time.

The ordinary distinction is observed between perception and idea; perception is based on sensation, as we have seen; it is the meaning which sensation acquires, while idea is similarly related to image. "The image is no more identical with the idea than sensation is identical with perception. The image is only one constituent of the idea; the other and more important constituent is the meaning which the image conveys." Our old difficulty arises here. Image is surely itself a 'meaning term.' Even as Stout has defined it, it differs from perception in lacking the external stimulus; it does not depart from perception in wanting meaning, but, as he puts it, in being worked out 'in the head.' It is, then, a representation, a 'mental picture.' As he himself illustrates it: "If I think about the Duke of Wellington, the image present to my consciousness may be only the shadowy outline of an aquiline nose." Think of the outline of an aquiline nose being conscious 'stuff,' devoid of meaning! It is two degrees removed; it is not only not a bit of consciousness, it is not an image; although one may have an image of it. The same confusion appears when the author turns to examine the characteristics of the 'mental image,' and asks: "In what respect does an object as merely imaged differ from the same object as actually perceived?" Not a psychological question at all, as it is put. To make the matter quite explicit we read a little farther on: "In what follows the object as perceived is simply called the 'percept' and the object as imaged, the 'image.'" Having gone so far, we are not surprised to come upon a serious discussion of Hume's 'force and liveliness' as 'distinctive of sensations.' Now it is one thing to compare sensations, peripherally and centrally aroused, with each other, and quite another to compare the 'percept' with the 'image.' Clearly, Hume's task was the latter. It must be said that the author enters into a more serious and painstaking investigation of idea and image than is commonly to be found in general treatises. His introspection is full and fresh, but not always free from ambiguity. In the following instances he does not seem to be quite sure-footed: "What the stimulus does for us in perception, we have to do for ourselves in ideation." "Images are maintained before consciousness purely by an effort of attention." "Ideas follow each other in accordance with purely psychological conditions." "In merely imaging 'the attention feels as if drawn backward towards the brain.'"

Under the heading 'Trains of Ideas' comes the discussion of Association and of Ideal Construction. The substance of the chapter is that associations are due to 'continuity of interest,' and the associated material is modified to suit the associating consciousness. There is little to note in the memory chapter. Memory is reproduction; some suggestions are offered towards raising its efficiency. In the treatment of comparison, conception and language we get back to the genetic problem, and, at the same time, come upon a delightfully clear and carefully thought out exposition of one of the cruces of psychology: the passage from the idea to the cognitive processes which stand upon the next higher level. After the stage of conceptual thinking is reached by the aid of language, whose function it is to break up the concrete items of sense perception and re-combine them into new wholes, the author proceeds to elaborate the process by which the external world and the self are produced as ideal constructions. The first motives to such construction are found to be practical: the bringing coherence and order into experience and the adjustment of the individual to his fellows in the community.

With Royce and Baldwin, Dr. Stout gives the social factor peculiar importance in this process. Involved with these constructions is the matter of belief and the distinction between belief and imagination. With Bain, the author finds the key to belief to lie in its relation to

activity. Here again the influence of society is emphasized.

The feeling attitude is considered not only on the levels of sensation and of perception, but also now in connection with ideas. Ideational activity itself is said to possess feeling-tone; this is connected with the furtherance and obstruction of conation; furtherance, the working out of the activity, giving pleasure and its opposite, pain. It is to be noted that the three references to feeling, upon the three developmental planes, involve some ambiguity in the use of terms. Pleasure and pain, and pleasantness and unpleasantness are often confused. It would have aided the student if different terms had been used to denote simple affection, the feelings of the perceptual stage, and the more involved hedonic aspects of discursive thinking. As an example, pain is often used where simple unpleasantness is evidently meant; as in the checking of a 'conative activity.' The distinction between pain and 'pain-sensation' is also confusing.

Finally, in the last chapter, the reader comes within sight of what he has been looking for all the way through; some systematic explanation of conation and of conative development. The reviewer is inclined to think that, without a previous analysis of conation, and also of impulse and of attention, many steps in the author's argument would be incomplete. Perhaps the full treatment in the *Analytic Psychology* is sufficient. Still, considering the difference in the two audiences which the author reaches, it is, perhaps not demanding too much to ask for a more complete analysis of these terms which are used constantly throughout the book.

The author acknowledges a very great debt to Dr. Ward, and the influence of the master is prominent all through the work. Naturally, Professor James' general point of view is also approached; although in matters of special interpretation Stout dissents from his opinion more often than he accepts it. While the book is predominantly British in its mode of treatment, it comes nearer a compromise between English and German psychologies than does any book which we have yet had from a writer of the English school, excepting, perhaps, Professor Sully's psychology. When one considers the product in connection with the soil to which it is indigenous, one can but note the marked effects of fertilization from imported systems. Although the *Manual* will scarcely fulfil at present a textual function in the class-rooms of our colleges and universities, American psychologists will know it and will find it stimulating and helpful.

Finally, to revert to the query with which we set out, we shall have to say that the genetic standpoint is not maintained with the rigor which we were led to expect from the author's preliminary definition of it; but that where it has been adhered to, it is used with profound psychological wisdom and a keen insight into the dark vistas of mental development.

I. Madison Bentley.

Cornell University.

Matières odorantes artificielles. Georges-F. Jaubert. Docteur és Sciences, ancien Préparateur de Chimie á l'École Polytechnique. Petit in-8. Pages 190. (Encyclopédie scientifique des Aide-Mémoire.)

The title of this book is both misleading and vague. It is misleading because it does not cover the indicated field, but only discusses three classes of odorous substances, the remaining classes being reserved for the author's forthcoming volumes on 'Les Produits Aromatiques' and 'Les Parfums Comestibles,' the subject thus being distributed through the three volumes. Further, it is vague, in that it is not, as might be expected, a bird's-eye view of synthetic perfumes, for at least one-third of its space is taken up with compounds which have no interest whatever as perfumes, and which apparently are inserted, either from their chemical relationship to other substances in the tables, or because, although possessed of no valuable odor themselves, they happen to occur associated with some natural perfumes in certain essential oils. The reviewer is of the opinion that the author might better have confined himself to a tabulation of those synthetic organic compounds whose odor renders them of commercial value, or which are of scientific interest from their being identical with certain natural aromas.

The author proposes the terms 'odorophore' and 'odorogen,' to be used in a manner analogous to the 'chromophore' and 'chromogen' of the color chemists. Thus, he considers the phenolic OH as an odorophore, which becomes an odorogen when its H is replaced by an alkyl or acyl group; in support of which he cites the following examples:

$HOC.C_6H_4.OH$ (paraoxybenzaldehyde) = little odor.

$HOC.C_6H_4.OCH_3$ (anisic aldehyde) = odor.

$HOC.C_6H_3<^{OH}_{OH}$ (protocatechuic aldehyde) = little odor.

$HOC.C_6H_3<^{OCH_3}_{OH}$ (vanillin) = odor.

$HOC.C_6H_3<^{O}_{O}>CH_2$ (piperonal) = odor.

The work is divided into the following chapters:

I. Halogen and Nitro Compounds.—Includes the halogen derivatives of phenylethane, and of styrol; mirbane and Musc Baur.

II. Aldehydes, Dialdehydes and Oxyaldehydes.—Among the more important aldehydes listed are those of benzoic, phenylacetic, cuminic, cinnamic, salicylic, anisic and piperonylic acids. Vanillin, however, is reserved for the author's volume on 'Les Parfums Comestibles.'

III. Phenols and Phenolic Ethers.—Among others the following are discussed: thymol, carvacrol, anisol, diphenyl ether, anethol, betanaphthyl ethers, eugenol and safrol.

Each chapter begins with a few pages of explanatory text, followed by a tabular classification of the compounds belonging to that particular group. The column headings, for the tables are as follows: trade name; scientific name; formula, empiric and constitutional; method of preparation; literature and patents; properties and characteristic reactions. The references to the literature and patents are particularly valuable.

Although the compounds are well arranged in a logical chemical classification, an Index would nevertheless be a desirable addition.

MARSTON TAYLOR BOGERT.

BOOKS RECEIVED.

Elements de paléobotanique. R. ZEILLER. Paris, G. Carré and C. Naud, 1900. Pp. 421.

A Treatise on Zoology, edited by E. RAY LANKESTER. Part III.: Echinoderma, F. A. BATHER, J. W. GREGORY, E. S. GOODRICH. London, Adams and Charles Black, 1900. Pp. vi + 344.

First Book, Home Geography and the Earth as a Whole. RALPH S. TARR, FRANK M. MCMURRY. New York and London, The Macmillan Company, 1900. Pp. xv + 279.

Prantl's Lehrbuch der Botanik. FERDINAND PAX. Leipzig, Wilhelm Engelmann, 1900. Pp. viii + 455.

Reinhardt's Technic of Mechanical Drafting. CHARLES W. REINHARDT. New York, The Engineering News Co., 1900. Pp. 36. 10 Plates.

SOCIETIES AND ACADEMIES.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, on the evening of April 2, the following subjects were presented:

A paper by Dr. H. von Schrenk, entitled 'A Severe Sleet-storm,' and embodying the results of a study of the injury to trees and shrubs by an unusually severe recent sleet-storm, was presented by title.

Dr. W. H. Warren read a paper giving an outline of recent progress in the chemistry of perfumes. For the most part, these substances are high boiling oils. Formerly these oils, which are complex mixtures of several compounds, were obtained exclusively from flowers, but recently some of the essential principles have been produced by chemical means, whereas other artificial perfumes are mere imitations. With a few exceptions the essential principles, which give the perfumes their value, belong to a complex class of organic compounds known as the terpenes. The terpenes are reduction products of cymol. The molecule is characterized by the presence of an atomic linking such as is found in the hydrocarbon ethylene, and the determination of the exact location of these ethylene linkings constitutes a difficulty in studying the terpenes. It is found also that nearly every substance having the properties of a perfume has in its molecule certain atomic groups whose presence exerts a marked influence on the odor. Among the more important of these may be mentioned the aldehyde, ketone, ester, ether and alcohol

group. Besides those terpenes which have the ring-structure in the molecule, there are substances which have long chains of carbon atoms. Apparently such compounds should be classified with fatty compounds, but so closely do they resemble the terpenes in their properties and chemical behavior that they are placed with them instead. Citral or geranial, an aldehyde found in largest quantity in oil of lemon-grass, is such a substance. Citral is of importance because it is the starting-point in the synthesis of ionone, the artificial violet perfume. The wonderful progress in our knowledge of the terpenes and of their derivatives is the work of scarcely more than ten or fifteen years at the most. There is great activity still, and among those chemists who have taken a prominent part in the labor should be mentioned Wallach, Baeyer and Tiemann.

Six persons were elected active members of the Academy.

William Trelease,
Recording Secretary.

THE TORREY BOTANICAL CLUB.

At the meeting of Torrey Botanical Club on March 13, 1900, a paper was read by Dr. P. A. Rydberg, on the 'Phytogeography of Montana.' He divided Montana into three regions, the Great Plains, constituting about one-half of the State, and the sub-Alpine and the Alpine regions, the last constituting those isolated peaks which exceed 9000 feet. The characteristic plant-coverings of each region, termed formations, were classed under the usual groups as Xerophytic, Mesophytic, Hydrophytic, and Halophytic, which were fully discussed.

Dr. Rydberg's paper was followed by remarks by Judge Brown on the beauty of the mountain flora, and by Dr. Britton on the Dodge expedition of 1897, of which the paper is a result. Dr. Rydberg said in answer to Dr. Underwood that the Montana flora extends but little westward of the State. Dr. Underwood referred to the interest attaching to any possible influence of hot springs upon the flowering-time of plants growing near, and called attention to the very early flowering of *Ranunculus Cymbalaria* along ditches supplied with hot water baths near Syracuse, New York.

Edward S. Burgess,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 322d meeting was held on Saturday, April 21st. L. O. Howard exhibited, with explanatory remarks, 'Some New Illustrations of Insects,' comprising series illustrating the different genera of mosquitoes, the species of flies presumably connected with the carriage of germs of diseases of the intestinal tract, and of fig caprification in California.

F. W. True spoke of 'The Newfoundland Whale Fishery,' his remarks being illustrated by lantern slides. The fishery for finback whales carried on at Snook's Arm, Notre Dame Bay was described in some detail, the speaker stating that a small, swift steamer was employed which cruised in the adjacent waters where the whales were taken by means of a harpoon gun. After being killed the whales were towed to the harbor and by the use of a steam winch hauled out upon an inclined plane where the blubber was rapidly removed.

F. A. Lucas.

DISCUSSION AND CORRESPONDENCE.

THE OFFICIAL SPELLING OF PORTO RICO.

To the Editor of Science:—Some time since there appeared in your paper a contribution from a distinguished Washington geographer to the effect that President McKinley had issued an order that the name of the island of Porto Rico should be spelled 'Puerto' Rico. There likewise appeared in the *National Geographic Magazine* for December, 1899, an anonymous personal communication stating in effect that I was the only government official who adhered to the form Puerto Rico.

I beg to inform you that in an Act of Congress passed April 11th and signed by the President of the United States, April 12, 1900, 'to provide revenues and a civil government for Porto Rico,' the word Puerto was stricken out wherever it occurred and *Porto* substituted therefore. The President's signature to this bill and the statutory act of Congress settles the spelling of the name of the island. Puerto

Rico is now a thing of the past, and like all unpronounceable foreign words has sacrificed its life to the dictum of the law of the least effort. It was never used by the American or English people and may now be laid upon the shelf with Nuevo Mejico, Nouvelle Orleans and others of their kind.

In determining this form of the word the Congress has followed the undoubted usage of the English language for 300 years and scotched an effort to fix upon our people and language a name and a principle which were never accepted by them.

ROB'T T. HILL.

LINGUISTIC FAMILIES IN MEXICO.

TO THE EDITOR OF SCIENCE:—In the *American Anthropologist* (N. S., II., 63–65), I have brought Pimentel's list of linguistic families in Mexico into harmony with the scheme of the Bureau of American Ethnology. It occurs to me that it will post the ethnology of the Republic up to date to add the names of families not mentioned by Pimentel, and to spell them in accordance with Major Powell's scheme for North America. Then families, language names, and tribal names will not be confounded: For example, the *Mayas* or *Maya* people, speak the *Maya* language, of the *Mayan* family. The *Mangues*, speak the *Mangué* language, belonging to the *Chiapanecan* family.

PIMENTEL'S LIST.	LIST PROPOSED.
Apache.	Athapascan
Chontal (Oaxaca.)	Zapotecan or Tequistlatecan
Guaicura y Cochimi-Laimon	Yuman
Huave	Huavan
Malalzingao Pirinda	Otomian
Maya-Quiché	Mayan
Mexicana	Nahuatlan*
Mixteca-Zapoteca	Zapotecan
Otomies	Otomian
Seri	Serian
Sonorense Ópata-Pima	Piman, or Nahuatlan
Tarasca	Tarascan
Totonaca	Totonacan
Zoque-Mixé	Zoquean.

NOT IN PIMENTEL'S LIST.

Chiapanecan, in Chiapas.
Chinantecan in Oaxaca.
Keresan or Kerean, in Chihuahua.
Tequistlatecan, Triquis and Chontals in Oaxaca.
Guaicura and Matlalzinga may prove to be families.

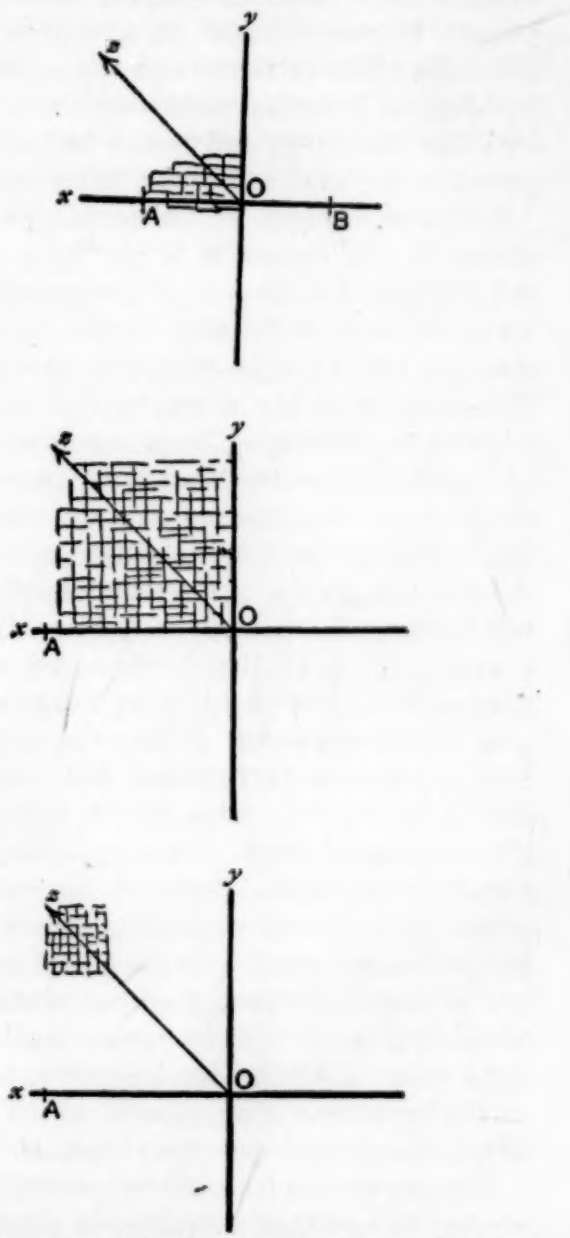
O. T. MASON.

*Professor Payne in History of America constantly uses Nahuatlacan.

HEMIANOPSIA IN MIGRAINE.

THE visual symptoms frequently occurring in migraine ('sick-headache,' so-called) have been described (see *e. g.*, Wood's *Reference Hand-book of the Medical Science, sub verbo*) by

FIGS. 1, 2, 3.



Optical symptom in migraine (Figs. 1–2). *O*, point of fixation in center of left hand held laterally 18 in. before the eyes. *AB*, length of hand. *OZ*, direction of development of symptom (hemianopsia in left upper quadrant). Fig. 1. Initial stage, true size (about), only symptom of any sort present. Fig. 2. Maximum stage, accompanied by massive headache, and beginning of nausea. Fig. 3. Final stage (before rapid fading), violent, more localized headache and nausea. (In Figs. 2 and 3, *AO*, equals *AB* of Fig. 1.) Duration of symptom 1 to 1½ hour. Symptom is invariably for recurrent attacks, and for monocular (either eye) and binocular vision; and has a fluttering wavy movement which cannot be figured.

medical authorities; but I know of no attempt to figure the appearance in the field of vision. Subjoined I give figures showing my own visual modification in three stages—initial, maximum and final—with the location and local progress of the symptom, taken during an attack last summer, after freedom from the headaches for years. It was brought on probably by the glittering effect of the sun on the water in sea-bathing, an inducing cause sometimes noticed by other observers, and rather frequent in the period of boyhood and youth in my own case.

The area covered by the peculiar net-work shown in the figures is bright light-gray and the configuration itself is of the appearance of water-bubbles or divisions. The lines are all straight and at right-angles to one another. The progress of the stigmate, if that term be allowed, is interesting from the point of view of theories of the localization of the trouble in the brain. The initial appearance covered the left half of the hand held eighteen inches before the face; it gradually spread leftward and upward (never downward or rightward) until it covered the whole hand when the gaze was fixed a little to the right of the hand and on the line of its lower edge. It then travelled off the hand by contracting upward and leftward (as shown in Fig. 3). This would indicate that the disturbance began in the right half of the visual area (occipital lobe) of the right hemisphere, or in the corresponding subcortical centers or tracts, spread over the entire upper half of that area (left upper quadrant of the field of visions), then died away progressively in the same order, this inference depending, of course, on the hypothesis of a projection of the elements of the visual area upon the retina.

It is interesting from the psychological point of view to note that a strong and persistent effort to call up the appearance, as for drawing a figure of it or describing it, produces in my case positive sensations of nausea.

J. Mark Baldwin.

Oxford, January 20, 1900.

The Development of Photographic Plates in the Light.

It may be of interest to your readers to know that if photographic plates in a camera are greatly over-exposed they may be developed in the light. A plate which should for ordinary work have an exposure of a second and a half for street or outdoor photography may be exposed for two hours. When developed with a weak hydrokinone by the light of a lamp, it gives a beautiful positive. The lamp is preferable because one can manage the degree of illumination. If the plate is held too near the lamp it will dissolve a picture already appearing. If held too far away the plate begins to fog. By moving toward or from the lamp the proper illumination may be soon secured. It is remarkable that a street scene taken in this way shows not a moving thing on the streets. Street cars passing every two minutes, wagons, horses, pedestrians, all have apparently vanished without leaving a trace upon the plate. But the fixed objects are shown perfectly, with their proper shadows and high lights.

In this way lantern slides and transparencies may be made directly without re-photographing from a negative.

Francis E. Nipher.

The Topographic Survey of Ohio.

The Ohio Legislature has just passed its appropriation bill for the year 1901. It contains an item of $25,000 for the inauguration of a topographic survey of the State, in co-operation with the United States Geological Survey. This insures the systematic beginning of the field work next year, and the friends of the measure are confident that it will be continued until the entire State is covered.

The initiative in the movement for securing co-operation was taken by the Ohio State Academy of Sciences at its annual meeting in December, 1896, since which time a committee of this body has been active in promoting the measure. At the legislative session of 1898 a bill passed the Senate and was in good favor in the House, largely through the earnest support given it by State Senator James R. Garfield. But the outbreak of the Spanish war necessitated a large appropriation for possible military expenditures, and so it was cut off. All parties gave the measure increased support in the campaign just closed. The scientific societies of the State, including the civil engineers and the

mining engineers, the college men, the wheelmen, the chambers of commerce and the principal newspapers all co-operated in securing the gratifying result already mentioned.

Ohio offers many interesting problems in topographic history, reaching as it does from the deeply-trenched, unglaciated southeastern portion, with its great systems of reversed drainage, to the flat lake plain of the north, with its beaches, moraines and buried channels. In due time this area will be added to that of the States to the eastward, where similar systems of co-operative survey are giving, or have already given, their topographic structure to the world in accurate and worthy maps.

ALBERT A. WRIGHT.

THE ARCHÆOLOGICAL REPORT OF ONTARIO.

THE usual Ontario Archæological Report by David Boyle has appeared for 1899. It is printed by Warwick Bros. and Rutter, Toronto, 1900, as part of the appendix to the report of the Minister of Education. Upwards of two thousand specimens have been added to the museum of the Education Department, Toronto. A number of pipes and other specimens are figured. Of special interest are a description and figures of two perforated skulls found in Simcoe County, Ontario. The perforations are considered to be post-mortem, or at least to have been made immediately before the individual's death. The skulls are considered to be of Huron Indians, and remind one of the similarly perforated skulls described by Dr. Henry Gillman. Mr. E. H. Crane, of Niles, Michigan, has a skull from the Saginaw Valley which is also perforated in this manner.

An 'Iroquois Medicine Man's' mask is figured and described, and a brief report is given of the exploration of mounds examined by Mr. Boyle on Pelee Island in Lake Erie. Mr. G. E. Laidlaw contributes a paper on new sites in Victoria County; Mr. Andrew F. Hunter, on sites of Huron villages in the township of Tay, Simcoe County, with some bibliographic references; Mr. W. J. Winternberg, on Indian village sites in the counties of Oxford and Waterloo. 'The Wyandots,' by William E. Connelly; The War of the Iroquois,' by M. B. Sulte; 'Notes on Some Mexican Relics,' by Mrs. Wm. Stewart; 'Music of the Pagan Iroquois,' with music by Mr. A. T. Cringan; and 'A Study of the Word Toronto,' by General John S. Clark—are also included in the report.

Mr. Boyle has patiently worked for years to create interest in the archæology of his province. These labors are at last being supplemented by assistance from other students in the same region. Until the subject is more studied, it is well that his efforts to preserve the records and specimens be encouraged.

HARLAN I. SMITH.

EXPERIMENT STATION EXHIBIT AT THE PARIS EXPOSITION.

AT the meeting of the Association of American Agricultural Colleges and Experiment Stations, held at Minneapolis in 1897, a resolution was adopted in favor of a co-operative experiment station exhibit at the Paris Exposition. A committee, consisting of H. P. Armsby, chairman; W. H. Jordan, A. W. Harris, M. A. Scovell, and A. C. True, was appointed to take charge of the matter. The stations were invited to contribute materials and charts illustrating special features of their work and results, original pieces of apparatus, models, designs, etc. The material as it was prepared was shipped to Washington. Dr. True, Director of the Office of Experiment Stations, undertook to make a collection of photographs and publications of the stations, to prepare a monograph on the experiment station enterprise of this country, and to look after the temporary installation of the exhibit in Washington and its final shipment.

The photographic exhibit includes about 750 selected pictures of station buildings, grounds, laboratories, apparatus, experimental plants, herds and other features, in addition to a collection of photographs of the station directors and staff members. The pictures are mounted in groups on sheets of heavy cardboard, 22 by 28 inches, and will be displayed in portfolios of twenty-four each.

A series of root cages, furnished by the North Dakota Station, shows the formation of the roots of maize, wheat, flax and brome grass; models of sweet potatoes, peppers, apples and

plums exhibited by the Iowa and Minnesota stations illustrate varietal differences; and an exhibit of saltbush from the California Station shows species of *Atriplex*, which have proved of value on strongly alkaline soils. Electrical devices for determining the salt content, temperature and moisture content, and a series of samples illustrating the typical agricultural soils of the United States, represent the soil work of the Division of Soils of the U. S. Department of Agriculture. The California Station sent six typical soils of that State, and specimens showing the results of mechanical analyses of each type of soil, and Hilgard's soil elutriator for mechanical analysis.

The California Station furnished an olive exhibit, consisting of fifty samples of olive oils and more than two hundred samples of olive pits used in the classification of varieties of olives; and the Alabama Station, a collection of mounted specimens of cotton, showing seventy-two selected and crossbred varieties.

Several pieces of original apparatus for investigations in vegetable physiology are shown, including an auxanometer for experimental work on the rate of plant growth; an apparatus for determining the rate of transportation of plants, from the West Virginia Station; and a centrifuge, used to study the effect of gravity and centrifugal force upon germinating seeds, from the Indiana Station.

Samples of animal and vegetable fats, a collection of chemically pure proteids separated from the seeds of various plants, a collection of one hundred weed seeds, an insect cabinet, a gas desiccator for drying hydrogen gas used in moisture determination, models of round and stave silos, an apparatus for the rapid cooling of wines, a pressure apparatus for experiments with solution under very high pressure, a model of the Atwater-Rosa respiration calorimeter and a full-sized bomb calorimeter are included in the exhibit.

The dairy exhibit is larger than that in any other line. It includes a series of cheese models from the New York State Station, showing the effect of the fat content of the milk on the size of cheese produced; a collection of forty-eight cultures of dairy bacteria, from the Connecticut Storrs Station; the original Babcock milk tester, two more modern forms of the apparatus for hand and power operation, together with a complete collection of the various forms of apparatus used in the Babcock test. The Scovell milk-sampling tube, Wisconsin curd test, Marshall rennet test, acid bottles and other minor apparatus are also included.

The irrigation exhibit of apparatus and models contains a hydrophore to determine the amount of silt carried by water; a nilometer used to measure the amount of water passing through streams, flumes and ditches; a current meter, water register, etc.

A small exhibit from the Hawaiian Experiment Station consists of samples of rocks, lavas, lava products, soils, varieties of sugar cane and samples of agricultural products, such as coffee, rice and sugar.

There is a large number of charts and enlarged pictures showing the results of experiment station work on a wide range of subjects, a complete set of bound bulletins and reports numbering several hundred volumes, and many miscellaneous publications of the stations, together with over one hundred books on agricultural subjects written by station officers.

The arrangement and shipment of the exhibit was in charge of Dr. W. H. Evans, of the Office of Experiment Stations, who also supervised the preparation of the charts and photographs exhibit.

Especial interest attaches to this exhibit from the fact that it shows the great progress made by our stations since the Paris Exposition of 1889, when the stations made only a small showing, as they were just beginning active operations under the Hatch Act.

SCIENTIFIC NOTES AND NEWS.

Dr. A. A. Michelson, professor of physics at the University of Chicago, has been elected a corresponding member of the Paris Academy of Sciences.

Dr. C. Hart Merriam has been elected a foreign member and Mr. Samuel Scudder a corresponding member of the Zoological Society of London.

The philosophical faculty of the University

of Göttingen has given the prize of the Wohlbrecht's foundation for works on natural science of the value of 12,000 Marks to Professor Gegenbaur the eminent Heidelberg zoologist.

PROFESSOR J. K. REES, of the Department of Astronomy of Columbia University, has been appointed an international juror in the department of the Paris Exposition, which is in charge of instruments of precision.

THE Government of India has decided to assign Captain Robert M. Elliot to the special duty of investigating on the nature and action of snake venom.

THE University of Edinburgh on April 14th, conferred its LL.D. on Dr. A. Stuart, professor of physiology in the University of Sydney; on W. R. Sorley, professor of philosophy in Aberdeen University, on Dr. C. D. F. Phillips, the pharmacologist, and on Miss Eleanor Ormerod, known for her contributions to entomology. On conferring this degree, Professor Grant remarked that it was the first time that the degree had been conferred by the University on a woman.

THE University of Glasgow, on April 17th, conferred the degree of LL.D. on Mr. A. Smith Woodward, of the Geological Department of the British Museum, and on Mr. Robert Caird, president of the Scottish Institution of Engineers and Shipbuilders.

IN honor of the twenty-fifth anniversary of Dr. Daniel Coit Gilman's election as President of the Johns Hopkins University, his colleagues in the faculty have presented to the University a three-quarter life-size oil portrait. It has been hung in McCoy Hall.

A BUST of the late Professor Egleston and a bronze tablet will be given to Columbia University by students of the School of Applied Science.

THE death is announced of M. Planchon, since 1886 director of the Paris School of Pharmacy at the age of sixty-seven years. He was a brother of the celebrated botanist Émile Planchon.

SIR WILLIAM PRIESTLEY, a well-known London physician and member of parliament, a grand-nephew of the discoverer of oxygen, died in London on April 11th at the age of eighty-one years.

RODNEY G. KIMBALL, since 1869 professor of applied mathematics in the Brooklyn Polytechnic Institute, died on April 25th.

THE death is announced of Mrs. Lankester known for her writings on botany and other scientific subjects, her best known work being the text of Sowerby's British botany.

THE death is also announced of M. Philippe Salmon, assistant director of the School of Anthropology, Paris, also president of the commission of megalithic monuments and member of the commission on historic monuments.

THE Senate has passed the agricultural appropriation bill, which carries $4,120,000, retaining the item of $170,000 for the purchase of seeds for distribution.

THE bill creating a National Department of Commerce and Industry will probably not be considered for lack of time during the present session of Congress, but special efforts will be made on its behalf next year.

BY the will of Charles E. Smith, formerly president of the Philadelphia and Reading Railway company, the Philadelphia Academy of Natural Sciences receives one-sixth of an estate valued at nearly $500,000, as also a collection of botanical books and a herbarium. His books on technical science are left to the Franklin Institute.

THE preliminary arrangements have been completed for taking the official observations in Mexico of the total eclipse of the sun on May 28th. These observations will be made by the National Observatory, under direction of the Federal Government. The places selected are Montemorelos and Santa Helena, both near Monterey. The astronomers appointed to perform the work are Francisco Rodriguez Rey, Manuel Morenoy Landa, Manuel Pasirana, Fernandez de Lindro, Augustin Aradon and Pedro Sanchez. Miss Rose D. Fallorend, of California, secretary of the Astronomical Association of the Pacific Coast, will also take observations of the eclipse from Santa Helena.

HERR MENCKE, of Hanover, is undertaking in his yacht a scientific expedition to the Ger-

man Islands in the South Seas. He will himself pay special attention to ethnology and will be accompanied by Dr. Heimroth, assistant in the Zoological Garden.

Nature states that Messrs. W. Goodfellow and C. Hamilton have lately returned from a successful expedition in the Colombian and Ecuadorian Andes, during which they made a collection of upwards of 5000 bird-skins, comprising examples of many rare species. The travellers landed at Buenaventura, on the Pacific Coast, in April, 1898, and thence crossed the Andes into the valley of the River Cauca. This was ascended, and, passing through Popayan, Messrs. Goodfellow and Hamilton entered the Republic of Ecuador, at Tulcan, proceeding thence to Quito, where a lengthened stay was made. From Quito excursions were effected to Pichincha, and to the low country on the Pacific Coast near Santo Domingo. Leaving Quito on March 1st, last year, Messrs. Goodfellow and Hamilton crossed the Andes to the upper waters of the Napo, and descended that river in canoes to Yquitos, in Peru, whence the journey home was effected by steamer. Mr. Goodfellow is preparing an account of the birds collected during this remarkable journey for the *Ibis*.

Professor John M. Macfarlane, of the University of Pennsylvania, has returned from an expedition to North Carolina, where he succeeded in obtaining a number of specimens.

Four zoological lectures have been arranged before the Zoological Society of London to be given on Thursday afternoon as follows:

April 19th—'The Animals of Australia,' Mr. A. Smith Woodward, F.Z.S.

May 17th—'The Freshwater Fishes of Africa,' Mr. G. A. Boulenger, F.R.S., F.Z.S.

June 21st—'The Gigantic Sloths of Patagonia,' Professor E. Ray Lankester, F.R.S., F.Z.S.

July 19th—'Whales,' Mr. F. E. Beddard, F.R.S., F.Z.S.

The following are among the lecture arrangements at the Royal Institution after Easter: Dr. Hugh Robert Mill, three lectures on studies in British geography; Dr. Alexander Hill, two lectures on brain tissue considered as the apparatus of thought; Professor Dewar, four lectures on a century of chemistry in the Royal Institution; Dr. Alfred Hillier, two lectures on South Africa, past and future. The Friday evening meetings will be resumed on April 27th, when a discourse will be given by the Right Hon. Lord Kelvin on 19th century clouds over the dynamical theory of heat and light; succeeding discourses will probably be given by Professor T. E. Thorpe, Mr. Sidney Lee, Professor J. A. Ewing, Mr. Francis Fox, Sir Henry Roscoe, and others.

The Springfield Zoological Club has arranged a series of lectures on some of the divisions of the animal kingdom, to be given in the Art Museum on Friday evenings. They will be given by Messrs. Chas. B. Wilson, F. F. Smith and Dr. Geo. Dimmock.

The position of assistant geologist in the U. S. Geological Survey, with a salary of from $900–$1200 per annum will be filled as the result of a civil service examination on May 22d and 23rd. The subjects and weights are:

(1) Essay on a geologic topic	10
(2) English composition (rated on subject one)	10
(3) Geology	40
(4) Drawing (rated on required work in subjects one and three)	5
(5) French and German	5
(6) Physics, chemistry, mineralogy and mathematics	10
(7) Education and experience	20
Total	100

Notice has been received at the Swedish and Norwegian consulate, in this city, that the King of Sweden and Norway has decided to reward persons who have found objects belonging to the Andrée Polar Expedition, and that a fund has been set aside for rewards for persons who may hereafter find objects from the expedition.

The 'Kaiserliche Gesundheitsamt' at Berlin, has established a biological section for the study of micro-organisms and other influences favorable or harmful to cultivated plants. The first publication from the section has recently been issued.

The annual general meeting of the Society of Chemical Industry will be held in London in July. Professor C. F. Chandler, of Colum-

bia University, the president and a number of American chemists expect to be present.

THE first meeting of the International Conference for the Protection of Wild Animals in Africa was held at the British Foreign Office on the 24th of April. The British representatives were the Earl of Hopetoun, G.C.M.G., Sir Clement Hill, K.C.M.G., C.B., head of the African department of the Foreign Office, and Professor Ray Lankester, director of the Natural History Museum.

THE twenty-ninth annual congress of German surgeons convened at Berlin on April 18th, under the presidency of Professor von Bergmann.

THE Jacksonian prize of the Royal College of Surgeons of England has been awarded to Dr. H. S. Lack for an essay on the 'Nasal fossæ.' The subject for next year is 'Bullet wounds of the chest and abdomen.'

THE first volume of the *Annals of the South African Museum* is completed with the issue of part 3, its 456 pages making a substantial contribution to our knowledge of the natural history of South Africa. The first article, Chap. XI. of the present instalment on 'New and Little Known South African Solifugæ in the Collection of the South African Museum,' by W. F. Purcell, contains descriptions of ten new species of *Solpuga* and of five little known species of the genus; four new species of *Dæsia* and three of *Ceroma*, these genera being recorded from S. Africa for the first time; also a new *Hexisopus* and the first description of a male of this genus. Chap. XII., also by W. F. Purcell, is devoted to descriptions of 'New South African Scorpions in the Collection of the South African Museum,' and Chap. XIII. contains 'Descriptions of Twelve New Species of the Genus *Mutilla* (Order Hymenoptera) in the South African Museum' by L. Péringuey. The final paper, Chap. XIV. is 'On Two New Species of Dicynodonts,' by R. Broom. The title page and index for the volume are issued with this part.

THE Council of the Zoological Society has given instructions for the publication of an index-volume to the new generic names mentioned in the *Zoological Record*, Vols. xvii.–xxxvii. (1880–1900). The volumes previous to Vol. xvii. have been indexed in the 'Nomenclator Zoologicus' of Scudder, published by the Smithsonian Institution in 1882. The contemplated index-volume of the *Zoological Record*, in order to increase its usefulness, will include names omitted from Scudder's list and from the volumes of the *Zoological Record*. Thus zoologists may have at their disposal (in the 'Nomenclator Zoologicus' and the new index together) a complete list of all the names of genera and subgenera used in zoology up to the end of 1900. It is requested that anyone who knows of names omitted from Scudder's 'Nomenclator,' or from the volumes of the *Zoological Record*, will forward a note of them, together, if possible, with a reference as to where they have been noticed or proposed, so that the new list may be made practically complete. Such information should be addressed to the editor of the *Zoological Record*, 3 Hanover Square, London, W.; or to C. O. Waterhouse, Esq., British Museum, Natural History, S. Kensington, London, who is engaged in compiling the list.

UNIVERSITY AND EDUCATIONAL NEWS.

GENERAL THOMAS H. HUBBARD has given $150,000 to Bowdoin College to be used for a new library building.

PRINCETON UNIVERSITY and Lafayette College each receive about $45,000 by the will of Joseph Eastburn Smaltz.

MR. MICHAEL CUDAHY, of Chicago, has subscribed $50,000 toward the million dollars which Archbishop Keene is trying to collect for the Catholic University of America at Washington.

MISS ELIZA T. BRYSON, a generous benefactor of Teachers College, Columbia University, has bequeathed to the College $2500 for a scholarship.

VANDERBILT UNIVERSITY will celebrate with special ceremonies, in October next, the twenty-fifth anniversary of its opening.

THE University of the State of New York will hold its annual convocation on June 25th, 26th and 27th. Among the subjects to be discussed are manual training and libraries. It is

expected that Mr. Hamilton Mabie will deliver the address on Tuesday evening. Dr. Nicholas Murray Butler of Columbia University, will present the report on the organization and plans of the joint college entrance board for the Middle States and Maryland. This report will be discussed in 10-minute speeches by President J. M. Taylor of Vassar, Dean Albert Leonard of Syracuse University, Dean Edward R. Shaw of New York University, and others.

At the April meeting of the Regents of the University of Nebraska, Dr. E. Benjamin Andrews, for some time Superintendent of Schools in Chicago, and formerly President of Brown University, was elected Chancellor of the University. His acceptance has been received, and he will assume his new duties August 1st, until which time Dr. Charles E. Bessey will be the acting chancellor. Dr. Charles A. Ellwood was elected instructor in sociology. An order was passed authorizing the Faculty to grant certificates to students who complete the courses of study in the schools of agriculture, mechanic arts, domestic science, and physical education, these being but two or three years in length, and not leading to a degree. The Faculty of the College of Literature, Science and the Arts recommended the adoption of more flexible conditions of admission to the Freshman Class, of which English (4 points), Language (6 points, 4 at least in Latin), algebra (2 points), geometry (3 points), and history (2 points) are specifically required, while the remaining eleven points are to be made up of combinations selected under certain restrictions, from Greek, Latin, German, French, history, physical science, natural science, advanced algebra, plane trigonometry, physiology, physiography, civics, and political economy. This recommendation was adopted by the Regents. The Faculty of the Industrial College made a similar recommendation, the specifically required points being English (4 points), Language (4 points, French, German, Latin or Greek, not more than two), algebra (3 points), geometry (3 points), physical science (2 points, chemistry *and* physics), natural science (1 point, botany *or* zoology). The remaining eleven points are to be made up of combinations, selected under certain restrictions, from French, German, Latin, Greek, manual training, history, physical science, natural science, plane trigonometry, mechanical drawing, physiology, physiography, civics, and political economy. This recommendation was adopted by the Regents. By action of the Regents the experiment will be made of having the college work almost entirely elective in the College of Literature, Science and the Arts, while in the Industrial College it will be (as now) very largely prescribed both as to subjects and sequence. The recommendations of the Faculty of the Graduate School in regard to admission to graduate work, and candidacy for advanced degrees, were adopted. But two degrees are offered, viz, Master of Arts, and Doctor of Philosophy, the first requiring at least one year of resident work, and the second not less than three years of work 'under properly qualified teachers,' the last year being in this University.

A department of marine engineering has been inaugurated at New York University, with Professor C. C. Thomas at its head.

The Adam T. Bruce fellowship in biology of the Johns Hopkins University has been conferred upon Lawrence Edmonds Griffin, Ph.B. (Hamline University). Mr. Griffin will go to Jamaica during the summer to pursue special research work.

Miss Margaret F. Washburn, Ph.D., professor of philosophy in Wells College, has been appointed Warden of Sage College, Cornell University.

Mr. B. Moore, M.A., professor of physiology at the Medical School of Yale University, and lately assistant professor of physiology at University College, has been appointed lecturer on physiology at the Charing Cross Hospital Medical School.

Dr. Eckstein has been appointed professor of zoology in the School of Foresty at Eberswalde. Professor Ramaun, professor of agricultural chemistry at Eberswalde, has been called to the University of Munich.

Dr. Bergt, of the Dresden Polytechnic Institute, has been appointed assistant professor of mineralogy at the University of Greifswald.